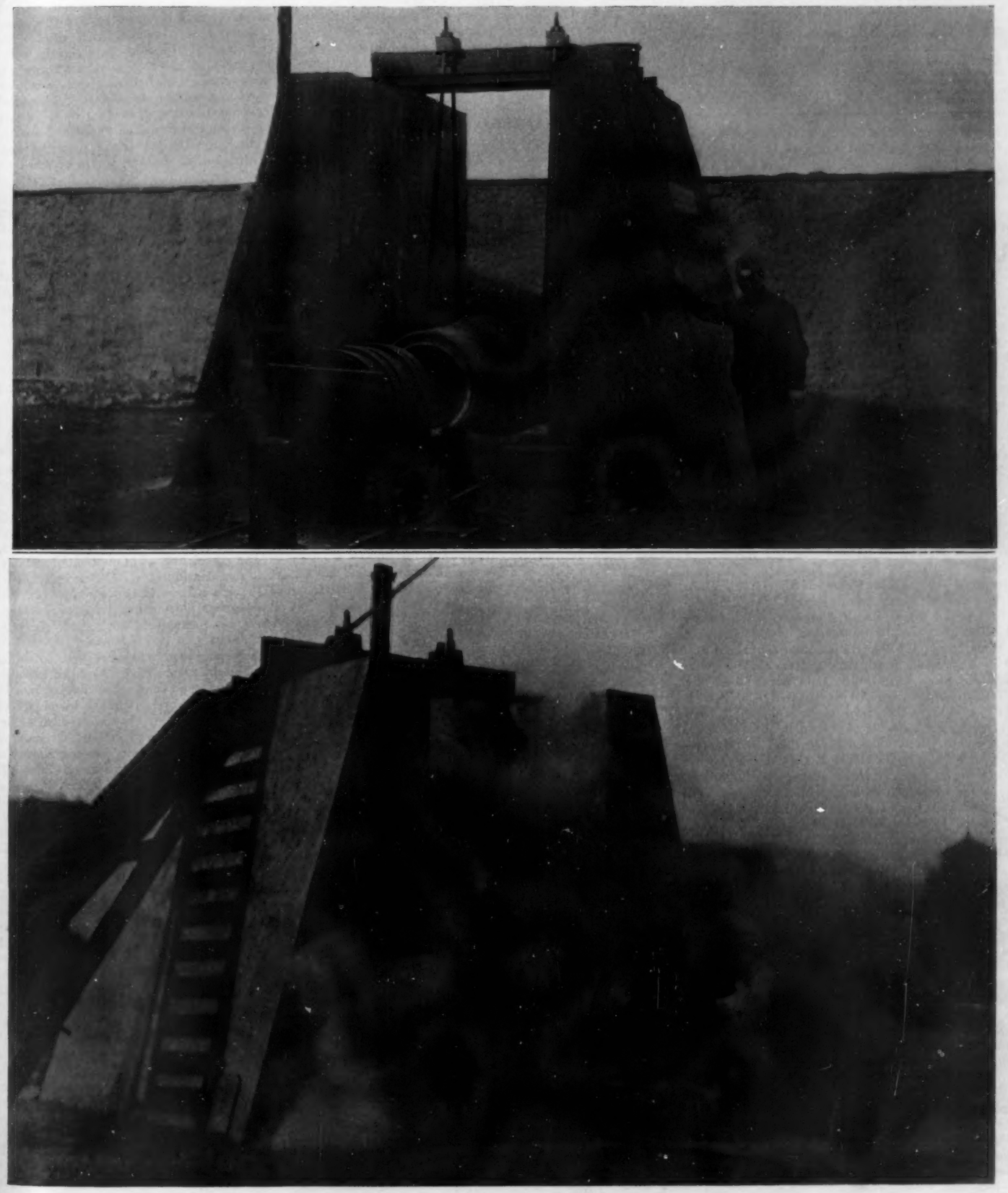
SIXTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CV. NUMBER 23. ★ NEW YORK, DECEMBER 2, 1911 ★ 10 CENTS A COPY $3.00 A YEAR



FIRST NATIONAL MINE SAFETY DEMONSTRATION.

Testing explosives. Two mortars, one on wheels, the other suspended, are charged with the explosive and placed mouth to mouth. When detonated, the swing of the suspended mortar indicates the power of the explosive.—[See page 498.]

SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, DECEMBER 2, 1911

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary and Treasurer; all at 361 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter

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Subscription one year $3.00
Postage prepaid in United States and possessions, Mexico, Cuba, and Panama

Subscriptions for Foreign Countries, one year, postage prepaid, 4.50
Subscriptions for Canada, one year, postage prepaid, ... 5.75

The Scientific American Publications

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Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Our Trade With South America

AMONG the subjects of national importance which should command the attention of every enlightened citizen of the United States is that of the trade of South America and our own particular relation thereto. We commend for careful perusal the bulletin of the Pan-American Union for October, which deals with the trade of Latin America for the year 1910. The growth of the commerce of the twenty republics dealt with since 1897 is shown by the fact that whereas in that year the total commerce was $910,422,500, in 1910 it had increased to $2,343,744,000, a gain of over 150 per cent, which, is about equally divided between imports and exports. These figures reveal the important and unsuspected fact that in the matter of commercial expansion Latin America has forged ahead more rapidly than the United States, the growth in foreign trade during the period referred to being $1,433,000,000 for the Latin American republics, and $1,581,000,000 for the United States.

During 1910, 55.2 per cent of the imports into the republics of North America came from the United States and to the South American republics we sent 13.64 per cent of their total imports. Taking the whole group of the Latin American republics, both in North and South America, we find that the United Kingdom leads with 26.03 per cent of the total imports, followed by the United States with 23.31 per cent. The third place is held by Germany, with 15.4 per cent, followed by France, with 8.21 per cent. The United States lead in the matter of exports received from Latin America, with 34.51 per cent, the United Kingdom, with 20.99 per cent, being second, Germany, with 11.47 per cent, third, followed by France, which takes 8.29 per cent of the exports. Seventy-five per cent of the shipments from the republics in North America come to this country, but we receive only 20.3 per cent of the shipments from the southern republics.

We are free to confess that the results shown in this bulletin are more favorable, as regards the position of the United States in the Latin American trade, than we had supposed them to be. At the same time, in view of the great geographical advantage enjoyed by this country, as compared with our commercial rivals in Europe, our trade with the southern republics is far below what it should be. A better system of banking, one more adapted to conditions in South America; the exercise of greater care in selecting the representatives of our commercial houses who go down and get into personal touch with the Latin American business men; a more intelligent study of the character, disposition, tastes, manner of doing business, and particular ways and wants of the people down there—all this, coupled with the creation of a merchant marine specially constructed for the South American trade, would do wonders in the extension of our Latin American commerce.

Personality and manners count for a very great deal with the Spanish American. There is probably no section of the earth where "bluff," "push," and general "get-there" methods count for so little, except as destructive agencies. The German, always analytical and scientific in his methods, thoroughly understands this fact; and the great commercial houses in Germany select their representatives with a special eye for their fitness for meeting and adjusting themselves to the idiosyncrasies of the Latin American customer. Instead of trying to make the people buy what he makes, the German tries to make what the people buy—a very simple, but a very radical and far-reaching distinction. More than that, he is careful to pack the goods and deliver them in just that very way which will render them acceptable to the customer and fit in most comfortably with his established habits and the general local conditions.

The Quebec Bridge Competition

ALMOST important contribution to the literature of bridge engineering is an article by Gustav Lindenthal, in our contemporary, *Engineering News*, on the Quebec bridge competition, which not only throws a flood of light upon the inside history of this great undertaking, but also affords a mass of instructive technical information for those who are interested in the construction of long-span bridges.

The Quebec bridge owes its celebrity mainly to the fact that it contains a longer single span than any bridge as yet constructed, its nearest competitors being the Brooklyn suspension bridge, with a main span of 1,595 feet, the Williamsburg suspension bridge, which measures 1,600 feet between towers, and the Forth bridge in Scotland, a cantilever structure, with two main spans, each measuring 1,710 feet in the clear. The cantilever structure which is to be built near Quebec will be 1,800 feet in the clear between centers of main piers.

In 1889 the Quebec Bridge Company invited tenders for a structure to carry a two-track railroad with a wagon road and trolley line on each side. Out of six competitors, the Phoenix Bridge Company was awarded the contract for the construction of a cantilever bridge prepared by its own staff of engineers, the award being made on the ground, among others, that this company's plan was the lowest in price. The construction was commenced, and when one-half of the bridge had been erected, the structure collapsed under its own weight, with the loss of eighty lives and four million dollars in property destroyed. "The primary cause of both disasters," says Mr. Lindenthal in the article referred to, "was the same: bad engineering; but in connection with the Quebec bridge was a contributory circumstance, of which it is difficult for engineers to speak without a feeling of humiliation, and that is the beggarly compensation for engineering services on a work of unprecedented magnitude, and the willingness of an engineer of high reputation and unimpeachable integrity to assume very important and laborious duties for a fee for which they could not possibly and seriously be met."

In this connection we wish to emphasize the fact that in all great engineering works of this character, the very last direction in which economy should be practiced is in that of the employment of the highest type of professional men, both for the design and oversight of the work. When such men are engaged, the remuneration should be on a scale which will justify them in allotting that measure of their own time and of the time of their office and field force, to the work, which the importance of the job demands. We need go no further back than the recent failure of the Austin dam for another object lesson in the folly of practicing overzealous economy in the matter of professional engineering services.

The bridge fell because one of the main compression members in the bottom chord of the shore or anchor span, which had been designed to stand a pressure per square inch of about 30,000 pounds before beginning to give way, failed suddenly and without warning under about one-half that load, or to be exact, under 16,800 pounds per square inch pressure. Mr. Lindenthal scouts the theory advanced in some quarters that the blame is to be ascribed to lack of scientific knowledge of compression members, which it was alleged could be derived only from full-size tests of large columns. He rather lays it to the fact that no studies of any kind were made for the unprecedentedly large compression members of the Quebec bridge until after their failure. Says he, "The leading consideration for the choice of their cross-sections seems to have been the desire of the contractor for cheap manufacture, which was not balked by the engineer. The chord members consisted each of four slabs or ribs composed of a number of thin, stitch-riveted plates, with contact surfaces painted or rather greased, insufficiently stiffened with flange angles and flimsy lattice angles. They were of a form so obviously defective that they should have been condemned at first sight. They were a pernicious example of commercial engineering, which may be defined for this case as the subordination of design to the cheapest methods of manufacture, under the pretense of fulfilling specifications."

The fall of the bridge was investigated by a Royal Commission of three Canadian engineers, who made an exhaustive and able report. Unfortunately the Canadian Government dispensed with the aid of that commission, whose report formed the basis of favorable comment at the time in the columns of the SCIENTIFIC AMERICAN, and appointed a new board, which, after much labor and time brought forth an official design, which, according to Mr. Lindenthal, cost the Canadian Government about five hundred thousand dollars and two and a half years' time of the Board. Bids were invited on this design, and bridge companies were invited to submit designs of their own; but they were expected to prepare these in four months' time and without any compensation whatsoever. Ultimately, out of the many and costly competitions, which included about twenty-four tenders and eight or nine competitive plans, and tenders varying from eleven million to sixteen million dollars, an independent design, drawn up by a Canadian company "in contravention of the official specifications," providing for limited traffic capacity and costing only nine million dollars, was accepted by the Canadian Government.

Had the design for this bridge been thrown open for world-wide and unrestricted competition by the leading bridge engineers of the world, the Canadian Government would undoubtedly have secured a better bridge, and certainly would have saved an enormous sum of money. In the latter half of his article, Mr. Lindenthal, himself probably the leading authority on long-span bridges, will show that the Canadian government ultimately will have spent nearly eighteen million dollars by the time the St. Lawrence River bridge is completed, and this in spite of the fact that by a wise and judicious policy it could have secured a bridge of greater capacity with a large margin of strength, for a sum of less than ten million dollars.

Attempts to Produce Experimental Pellagra

SO far the study of the horrible disease known as "Pellagra" has produced nothing to point to the etiology of the disturbances it sets up. The Italian expert, Dr. Sambon, believes that it is an infectious disease, and that it is transmitted by the "buffalo gnat" (*Simulium reptans*); Dr. Lavinder, the specialist of the United States Public Health and Marine Hospital Service, thinks that the disease is a metabolic or food disease. But until the past year no one had tried to test the various theories by means of inoculations in one of the higher animals.

If Sambon's theory is correct, an infection should be possible by means of the blood of a patient, since the organism that causes the disease must at some stage or other be present in the blood. To test this supposition, Dr. John F. Anderson, director of Hygienic Laboratory, and Past Assistant Surgeon Joseph Goldberger obtained some rhesus monkeys (*Maccacus rhesus*) and inoculated them with defibrinated blood and spinal fluid from typical cases of Pellagra. Two of the monkeys showed slight discolorations of the skin on the face; these varied in intensity and disappeared after a short time, and they were different in the two monkeys. There was no fever or any other indication of disturbance after nine months.

Dr. C. H. Lavinder, although he does not believe the disease to be due to infection, also attempted to induce the disease in a number of rhesus monkeys. In three monkeys he made intraperitoneal injections of blood from a patient, in three injections of spinal fluid, and in three injections of spinal emulsions. The emulsion was also used to inoculate culture tubes, with negative results. After six months, none of the monkeys showed any symptoms.

Drs. Anderson and Goldberg suggest that the negative results may be explained in one of three ways:

1. The monkeys may not be susceptible to the disease.

2. The technic may have been defective.

3. The infective substance or agent may not have been in the blood or in the spinal fluid at the time it was drawn.

These explanations all assume that the disease is infectious. But even on that assumption there is still another explanation possible. If the disease is caused by an animal parasite and is transmitted by the *Simulium*, there is the possibility that the organism undergoes developmental changes in the secondary host, without which it is incapable of producing the disease again.

Hudson Maxim

A Noted Inventor of High Explosives

ALTHOUGH the subject of the present sketch has been a tireless worker in many fields of activity, his name is best known in connection with his work in the development of high explosives and their application to modern ordnance.

Hudson Maxim was the fourth son of a family of eight children—six boys and two girls. He was born February 3rd, 1853, at Orneville, Piscataquis County, Maine. His parents, Isaac and Harriet Boston (Stevens) Maxim, were of sturdy stock of English and French Huguenot descent.

In 1875 he formulated the hypothesis of the compound nature of the so-called atoms, which has only recently been generally accepted as a proven theory through experiments on radiant matter. His theory, as first published in brief in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 697, of May 11th, 1889, is that all matter is one in the ultimate, and that the difference in the various forms of matter and manifestations of force is due to the difference in the relative positions of the ultimate atoms.

From 1883 to 1888, Mr. Maxim was engaged in the subscription book publishing business at Pittsfield, Mass., and during this period he wrote and published a book on "Penmanship and Drawing" of which nearly half a million copies were sold by subscription. In 1888, he left the publishing business for the more fascinating occupation of inventing and experimenting with ordnance and explosives.

In 1890, he erected a dynamite and smokeless powder mill at Maxim, New Jersey, where he developed and manufactured the first smokeless powder to be adopted by the United States Government. The E. I. duPont de Nemours Powder Company, of Wilmington, Delaware, purchased his inventions and plant, engaging him as consulting engineer and expert in experimental work.

Following exhaustive experiments by the United States army at Sandy Hook, Mr. Maxim sold this Government in 1901 the secret of his high explosive Maximite. It was the first high explosive to be successfully employed as a bursting charge for armor-piercing projectiles.

Among the others of his successful inventions is a detonating fuze for high explosive projectiles, which has proven itself superior to all rival fuses, and has been recently adopted by this Government. A later invention is stabillite, a new smokeless gunpowder, which in addition to other desirable qualities, has the great advantage that it may be used as soon as produced. This, in view of the fact that ordinary nitro-cellulose smokeless powder requires several months to dry, renders stabillite of the greatest importance in the event of war. For the larger guns, more than a year is often required to dry out the solvent. Stabillite does away with all this difficulty.

Simultaneously with the invention of stabillite, Mr. Maxim produced a new self-combustive compound, which he named motorite, intended to be employed instead of compressed air for driving torpedoes of the Whitehead type. The motorite is made in bars about five feet long and seven inches in diameter. These bars are then coated on the outside and forced and sealed into steel tubes. The bar is ignited at one end, to which the combustion is confined until the bar is entirely consumed. Water is forced into the combustion chamber and is instantly converted into steam by the flame blast, the products of combustion and the steam mixing to produce a motive fluid which is employed to drive a turbine or other engine.

There is probably none of his inventions upon which Mr. Maxim has expended more time and effort than upon this. In addition to driving torpedoes it is also applicable for driving small torpedo-boats during the run of attack, and Mr. Maxim has designed a new type of torpedo boat, which itself forms a veritable torpedo, driven by motorite during the run of attack through the gun-fire of a warship. The boat will carry a ton of high explosive in the warhead, which will be delivered against the hull of the war vessel attacked.

The process of making calcium carbide continuously by the electrical resistance of a molten carbide conductor, removing the carbide as fast as formed, and simultaneously supplying fresh material to the heating fluid, now in general use in this country, was invented by Mr. Maxim, the invention being sold to the Union Carbide Sales Company in 1906. During experiments in the manufacture of calcium carbide, he invented a process for the manufacture of microscopic diamonds by electro-deposition.

Another late invention of his is a game of skill—an improvement on chess; it is called the War Game, the movements of the pieces simulating field operations of troops in battle.

He is the author of "The Science of Poetry and the Philosophy of Language," published by Funk and Wagnalls, 1910. The work embraces an exhaustive treatise on the nature and use of sounds in language, and contains many important scientific discoveries in the constitution and dynamics of human speech.

From the foregoing one can easily appreciate what a hard worker and tireless thinker this man must be, and yet, aside from inventive labors, he has won acknowledgment as writer, critic, philosopher and sociologist. He is an effective public speaker, and is also a frequent contributor to the leading periodicals on a wide range of subjects.

HUDSON MAXIM

Best known for his work in high explosives and their application to modern ordnance.

He is a member of the following societies: The Aeronautical Society of New York (of which he is past president); The Military Service Institution, Society of Chemical Industry, Chemists' Club, Navy League, Fellow of the American Association for the Advancement of Science, Director of the New England Society, 2nd Vice-President of the Aero Club of New York, President of the Hopatcong Rifle Club.

Mr. Maxim has had a great many narrow escapes in his long experience as an inventor and manufacturer of explosive compounds. In the manufacture of explosives, even after the work has become thoroughly systematized and the duties of the workmen become routine, there is an inseparable element of considerable danger; but in pioneer inventive work and experimentation with explosive materials, the risk of life and limb is very much greater for the reason that the experimenter is obliged to deal with unfamiliar compounds and unfamiliar reactions under unfamiliar circumstances.

The pathway of the inventor of explosive materials is like that of the vedettes of an army passing over a road planted with the torpedoes of the enemy. One becomes accustomed to the danger of explosives, Mr. Maxim says, just as a veteran soldier gets used to the dangers of battle; but it does not lessen the risk.

One day, seventeen years ago, at his powder works in New Jersey, Mr. Maxim was experimenting with a new fulminate compound, one of the most dangerous and deadly explosives known to science, when, owing to a little oversight, his left hand was blown off to the wrist.

At another time, at the same place, when one of his assistants was weighing out some of this dangerous material in the laboratory, an arm supporting the scoop of the scales gave way and a weight fell, striking within an inch of a quantity of fulminate which was piled on a piece of glass. Had the weight struck the glass, there would have been an explosion, and as there were ten pounds of fulminate in a jar standing on a bench, the explosion would certainly have had fatal results.

At another time, requiring some dry guncotton for an experiment, and not finding a suitable vessel to put it in, he was delayed a few minutes until one should be cleaned. During those few minutes, the guncotton house where he was going for the material blew up. At another time Mr. Maxim was conducting some experiments in throwing aerial torpedoes from a 4-inch cannon. These projectiles, charged with a high explosive, were fired into a sand bank one hundred yards distant. The line of fire being parallel with a line of railroad about one thousand feet away, no danger to the railroad was suspected. Several torpedoes had already been discharged and the gun was being reloaded when the whistle of a passing train was heard. The gun was fired, but the aerial torpedo, instead of striking into the bank and exploding, as the previous ones had done, glanced from the bank, mounted high in the air, and passed clear over the train into the swamp beyond, where it exploded with terrific force.

Once, when he was conducting some experiments with motorite, the combustion chamber exploded like a bombshell, blowing the windows of the workshop into the street, while the walls were pierced with fragments in all directions. Mr. Maxim and his assistant, though both standing in the room at the time, escaped without a scratch.

A smoker is often unintentionally the cause of many a conflagration, the exploder of fire damp in mines, and the cause of the blowing up of powder mills. No smoker and no one carrying matches is ever knowingly admitted into any powder mill or dynamite factory.

One occasion when Mr. Maxim confesses to have been thoroughly scared was when an intimate personal friend, a habitual smoker, escaping the vigilance of guards and assistants, entered one of the buildings at Mr. Maxim's experimental works on Lake Hopatcong, with a lighted and partially consumed cigar in his mouth, having an inch of hot ashes and cinders on the end of it ready to drop off at the least jar. When Mr. Maxim caught sight of him he was standing over a large box containing fifty pounds of dry guncotton, examining the material with his hand, and upon the same bench where the guncotton rested were two other boxes filled with smokeless gunpowder, one hundred pounds in each. Mr. Maxim went up to the smoker, threw a cover over the box, and quietly asked him please to stand back a little. Then he told him what he had done, and the offender was so scared that he nearly fell to the floor.

Technical Experts at German Consulates

IT is reported that the German government is about to create a new class of consular officers, viz., technical experts, who will be attached to important consulates and whose duty will be to follow the progress of industrial development in the country to which they are assigned, and to report on all novelties of a technical character. These officials will supplement the commercial experts already attached to many German consulates, who, though they are of great value in furthering the foreign commerce of the fatherland, lack the professional training necessary for answering the many technical questions addressed to the consulates by German manufacturers, engineers, etc., pertaining to the progress of applied science in the several foreign countries.

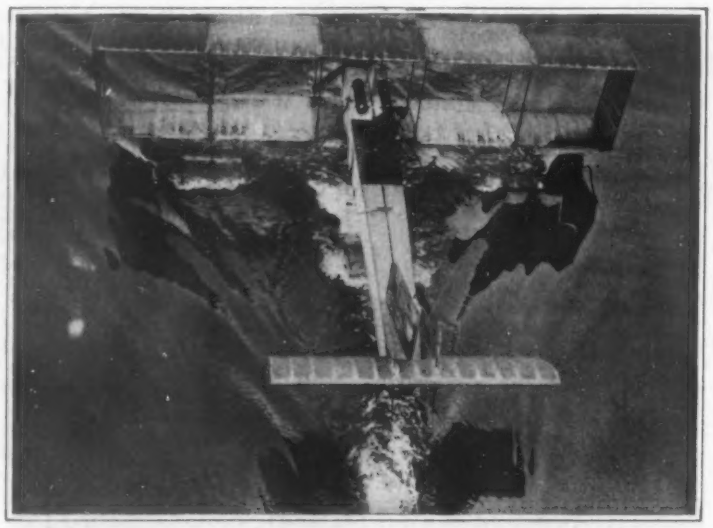
The Hydro-aeroplane

Some of the Latest Biplanes Which Have Been Fitted with Floats in Order to Make Soaring From the Water Possible

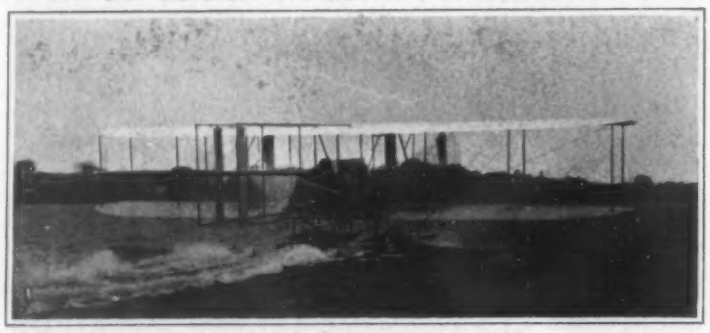
THE first experimenter to succeed in making an aeroplane rise from the surface of the water was the French inventor, M. Fabre, who accomplished this feat with a monoplane of his own invention the last of March, 1910. About a year later Glenn Curtiss, at San Diego, fitted a float to his biplane and made it rise from the water and alight thereon with complete success during the course of his experiments. He flew out to the cruiser "Pennsylvania" anchored off the harbor and was lifted aboard with his machine. After paying a short visit to the ship, the aeroplane was lowered once more and Curtiss flew back to his starting point within the harbor. During the past summer the hydro-aeroplane has been experimented with by officers of the navy and two Curtiss hydro-aeroplanes have been purchased. These machines have found favor on account of their shift control, which consists of a movable wheel in front of the two aviators and mounted upon a vertical arm pivoted at its lower end so that it can be swung in front of either man. By this means it is extremely easy to shift the control wheel of the machine from one to the other pilot whenever it is desired to do so. In their long flight from Annapolis to Hampton Roads recently, Lieuts. Ellyson and Towers found this control of great benefit, as they were able to take turns in running the machine. Quite recently Mr. Curtiss has received a large order for hydro-aeroplanes for the Russian navy, and he has sent one of his aviators to Russia to demonstrate these machines, while Capt. W. I. Chambers of our own navy believes that before long each battleship will have to carry one or more hydro-aeroplanes.

One of our illustrations shows Witmer skimming the surface of the waves in the Hudson River in one of the latest Curtiss machines. This biplane is mounted on a single float, the bottom of which is rounded upward at the front, while the top is rounded downward at the rear end. This float is made of wood and is 14 feet long by 2 feet wide by a foot in depth. It will sustain a weight of some 1,400 pounds without being submerged. The front horizontal rudder is mounted above the bow of the float, where it not only serves its purpose of steering the machine in a vertical plane, but also keeps the spray from striking the aviator. At each end of the lower plane there is an inclined air cylinder which acts as a buffer and buoys up the end in case the machine tips when skimming the surface of the water. Recently Hugh Robinson made a flight in one of these machines down the Mississippi River from Minneapolis, Minn., to St. Louis, Mo., for the purpose of demonstrating its use as a mail carrier. Some five thousand pieces of mail were carried, and mail pouches were taken on and put off at the various towns on the way.

Another of our illustrations shows the "Pelican" of Capt. Hugh L. Willoughby. Instead of a single float, Capt. Willoughby has built two long narrow floats with upcurved bows, which match the skids on his biplane. These floats are carefully constructed and are sheathed with brass, making them watertight. Their combined weight is but 103 pounds, or some 20 pounds less than that of the single Curtiss float. They will lift 1,200 pounds without submergence. The "Pelican" was fitted with only a 30-horsepower, 4-cylinder, Curtiss motor, which was not quite sufficient to raise it from the surface of the water. Now that he has transferred his machine to Sewell's Point, Va., he expects to fit a more powerful motor, and make flights above some of the streams in that vicinity. This new hydro-aeroplane is fitted with front and rear horizontal rudders which work in unison, the front one turning up, while the rear one points down, and *vice versa*. This is a system which has been used for some time by Farman, Curtiss, and the Wrights, but Capt. Willoughby has secured patents upon it, both in the United States and France. The shape of these rudders is practically triangular, and they have vertical triangular fins above and below. Triangular ailerons are also fitted at the rear ends of both planes. The inventor also has perfected a new form of throttle control whose action is just the reverse of the usual arrangement, in that when the pedal is pushed the throttle is closed and the engine slows down, while a full movement of the pedal short-circuits the magneto as well.



View looking down upon a Voisin "Canard" from in front.



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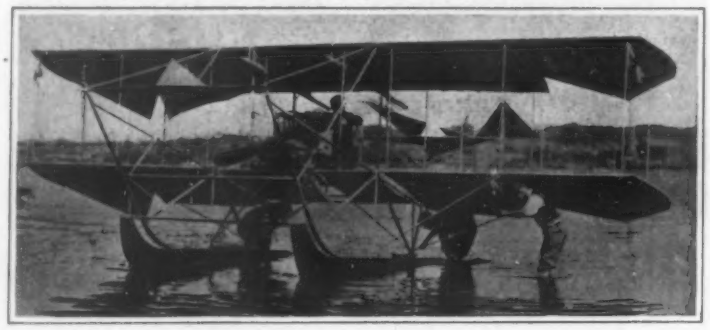
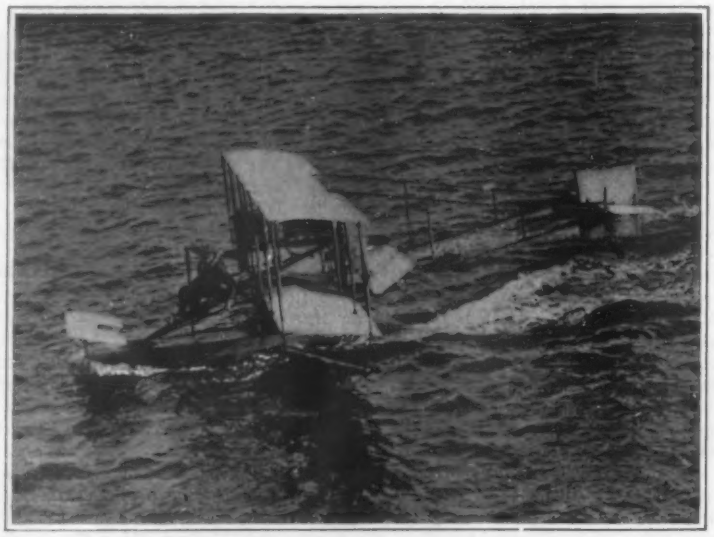
Rear view of Burgess-Wright headless hydro-aeroplane skimming the surface at full speed.



Capt. Willoughby's hydro-aeroplane "Pelican" resting on its upcurved floats.



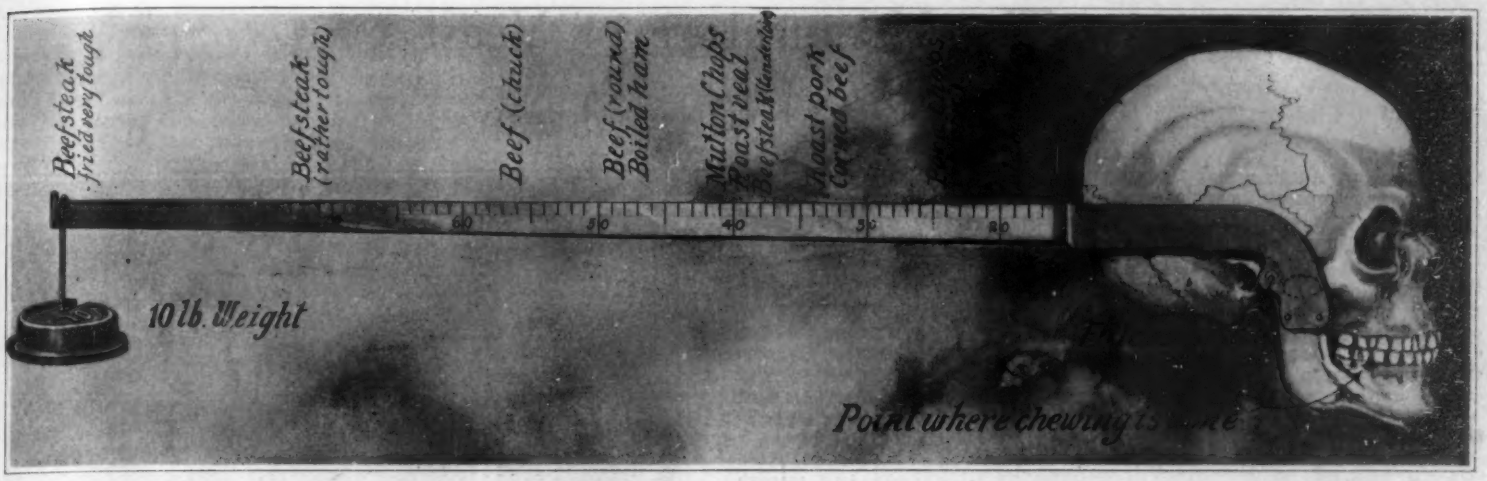
The single-float Curtiss hydro-aeroplane gathering speed in rough water.

THE HYDRO-AEROPLANE

Both the Wright and the Burgess-Wright companies brought out a hydro-aeroplane. A Burgess-Wright biplane, viewed from the rear, is shown skimming the surface of the water in one of our illustrations. Like the "Pelican," it is provided with double floats, but the skids instead of resting upon these floats, are rigidly attached to the aeroplane by means of suitable uprights. These floats are single-step, cedar wood hydroplanes 14 feet long by 2 feet wide, and having a 4-inch step placed about in the middle.

A fourth illustration shows, viewed from the front and above, the Voisin hydro-aeroplane known as the "Canard" (duck) skimming the surface of the water before soaring in flight. This biplane, which has a long body projecting forward in front, is mounted upon four floats, two of which are distinctly visible beneath the lower plane about half-way between the body and the ends. The third float is also visible beneath the body about half-way out from the front of the main planes. The horizontal and vertical rudders can be seen at the front end of the body, while the two men in the body are peering over the side as the machine travels forward. The propeller is also visible across the rear end of the body. This machine, mounted on wheels, was described some time ago in the SCIENTIFIC AMERICAN. During the past summer it was fitted with Fabre floats, and has made many successful flights from the surface of the Seine, near Paris. M. Fabre's original monoplane was built on the lines of the "Canard," and was fitted with small floats, placed in practically the same positions as they occupy in this machine. M. Fabre experimented for a long while before he was able to obtain floats that would stand the shocks of the waves and remain watertight. He finally found that several layers of veneer was the most suitable substance for this purpose.

Recently the Aeronautical Society has obtained grounds at Bergen Beach, near New York, for the purpose of making it possible for its members to experiment on the water next summer. As the members are alive to the possibilities of the hydro-aeroplane, without doubt there will be a number of these machines developed next year. The advantage of the hydro-aeroplane is that it can follow water courses that cannot be traversed by motor boats, and can travel much faster than any of these craft. In case of accident or a forced landing, there is always a good place upon which to alight. There are thousands of miles of rivers and canals in the United States above which amateur aviators can fly in safety, and without doubt another year will see a great development in the popularity of the new sport of hydro-aeroplaning.



To chew tough beefsteak, the jaw muscles must exert a 90-pound crush, here represented by a 10-pound weight on the end of a 30-inch scale-beam.

The Power of the Human Jaw

The Work We Do In Biting and Chewing

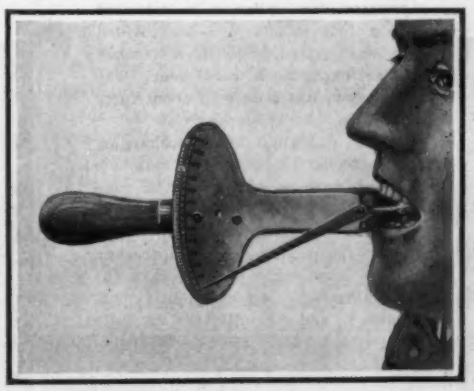
A TEN-POUND bite requires a forty-pound contraction of the human jaw muscles. That is because the jaws are built on the principle of a pair of tongs. The power is applied near the joint, while the work is performed at the opposite extremity of the jaw levers. Had a mechanical engineer designed the human frame, he would no doubt have built the jaws after the fashion of a nut cracker, with the muscles placed at the ends of the jaw levers, and the teeth between these ends and the joint or fulcrum, so that a powerful bite could be obtained with a very small expenditure of muscular effort. However, in the physiology of man and all other animal life, for that matter, mechanical advantage weighs for little in the presence of other broader considerations. This is why nearly all the principal muscles of the body must be far more powerful than would be necessary were they to act directly upon the work. When chewing we have an almost direct application of the power of the muscles, as they nearly overlie the third molars. There is a vast difference between chewing and biting.

The gnathodynamometer.

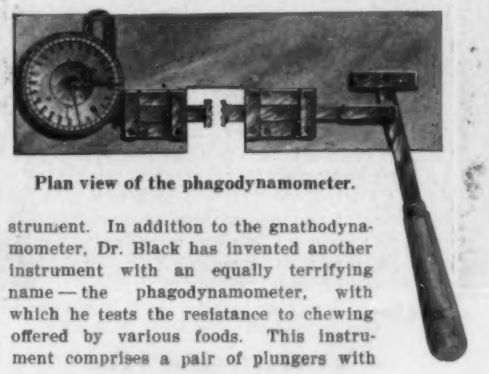
In order to determine the average strength of the jaws, Dr. G. E. Black, president of the Chicago Dental University, some time ago devised an instrument of very simple design but with a name that would put the average jaw to a severe test—the gnathodynamometer. With this instrument he made gnathodynamometric tests of the jaws of a thousand persons. They were selected at random, and probably represent a good average of civilized people. He found that the limit of the bite was not determined by the muscles, but by the teeth themselves. In nearly every case, the patient would cease his efforts, owing to the fact that his teeth hurt. This would depend largely upon the condition of the peridental membranes, and upon the habits of the patient in accustoming his teeth more or less to chewing hard foods. The average of the thousand persons showed 171 pounds for the molar teeth and much less for bicuspids and incisors. Out of the one thousand persons, seventeen developed a force equal to the full registry of the instrument, which was 275 pounds.

In a recent publication, Dr. Black has tabulated the records of about fifty persons who were tested with the gnathodynamometer. The list includes men and women of all classes, from a blacksmith to a Chinese laundryman, and from a servant girl to a music teacher. It is natural to picture a butcher as a man with a well-developed and powerful jaw, but among the patients in the list, the butcher showed a power of only 165 pounds with his molars, from which we may infer that he is accustomed to selecting tender meats for use on his own table. The man with the highest record was a printer who registered 270 pounds; (but any compositor will admit that printers' pie is tough) while the second honors went to a dentist with 240 pounds. Among the women the highest record reached was 160 pounds, while the lowest was 45. Strangely enough, the schoolgirl who made the latter record was able to register 70 pounds with her incisors, which might indicate that she had accustomed her dental membranes of the front teeth to harder work by biting a pencil, or something of the sort. At any rate she was one of those unfortunates who "bite off more than they can chew." In this list of records, males showed an average of 150 pounds with the molars and 83 with incisors, and females 108 pounds with the molars and 57 with incisors.

The instrument with which these records were made comprises a pair of steel arms, which are normally spread apart by spring tension. Each arm is equipped with a rubber pad, on which the biting is done. When the patient bites the pads, the levers are forced toward each other and cause an index needle to travel over a graduated arc which shows the force of the bite in pounds. One of the difficulties that had to be contended with was that the full power of the muscles cannot be exerted until the jaws are nearly closed. This made it necessary to reduce the biting pads to a minimum compatible with safety. In selecting patients whose jaw muscles were to be tested, it was imperative that the teeth be examined for any indications of decay which would weaken them to such an extent as to cause injury when biting on the instrument. In addition to the gnathodynamometer, Dr. Black has invented another instrument with an equally terrifying name — the phagodynamometer, with which he tests the resistance to chewing offered by various foods. This instrument comprises a pair of plungers with toothed surfaces at their adjacent ends. By means of a lever one of the plungers is forced against the other. The latter acts upon a spring, connected with an index needle arranged to sweep over a dial. The pressure of one plunger upon the other plunger may then be read on this dial. With this instrument, some important studies have been made of the force required in the mastication of food. These are shown graphically at the top of this page. In place of muscles the jaw is represented as being provided with a scale beam and a 10-pound sliding weight on the beam. If the weight be moved to the point marked 50, a fifty-pound crushing force will be exerted at the second molars.



A gnathodynamometric test of the incisors.



Plan view of the phagodynamometer.

Rear view of the device.

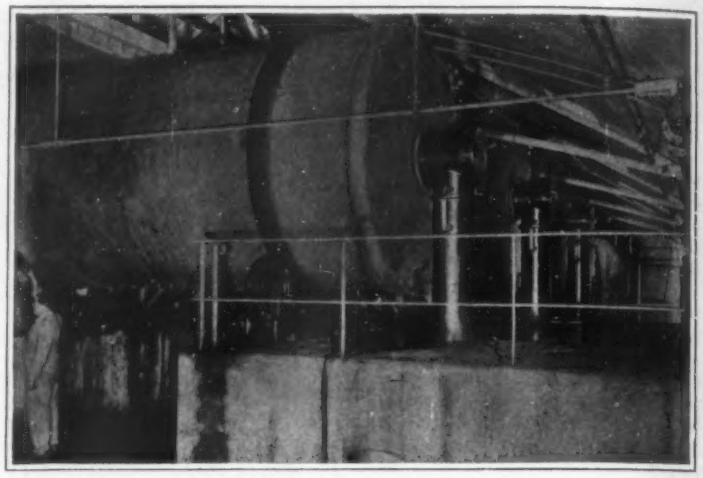
The tenderest meat was found to be boiled tongue, the central part of which offered a resistance of from three to five pounds. Boiled tongue, when cold, offered a resistance of from fifteen to twenty pounds. In order to crush pork chops, loin, a force of from twenty to twenty-five pounds was necessary. Mutton chops required from thirty to forty pounds; beef, round, from forty to fifty, and beefsteak, well done but rather tough, from sixty to eighty pounds. An experienced butcher selected some very tough meats, from the neck of an old animal, which stood up against a force of from seventy to ninety pounds before the crush occurred. These tests were made a number of years ago, before storage meat was used to the extent it is now. The figures should be reduced about one-third for meat made tender by storage. With these data, the mathematically inclined may proceed to figure out the horse-power developed at the boarding-house table.

A surprising fact brought out by the use of the phagodynamometer is that the hardness of food does not determine its danger to the teeth. For instance, candies that are quite hard offer much less danger to the teeth than gum drops, which ordinarily are mashed out of shape at from twenty to thirty pounds. If part of the gum drop became wedged between the cusps of the teeth, it was found that frequently it could not be completely crushed with a pressure of less than 250 pounds. Sticks of licorice proved particularly dangerous in this way. But the most remarkable discovery was that even bread might cause the breaking of a cusp. To quote Dr. Black, "With my personal observation, more teeth that seem sufficiently strong have been broken with bread crusts, and not very hard crusts either, than with any other one thing. I used sometimes to feel that persons relating these accidents were not quite honest in their statements, but when I tried the bread and found that it would wedge in between the cusps of the teeth, and not be crushed out with a force of 350 pounds, I changed my mind."

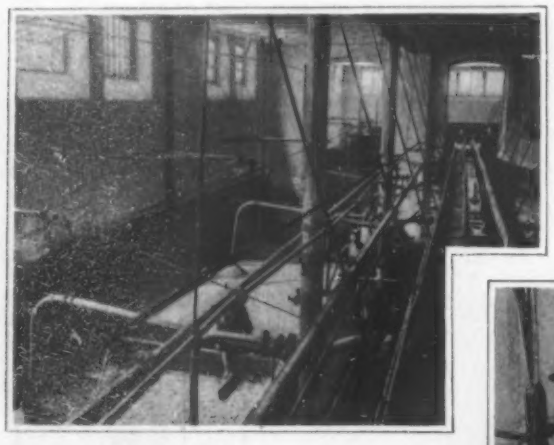
The Manufacture of Yeast

An Important Fermentation Industry

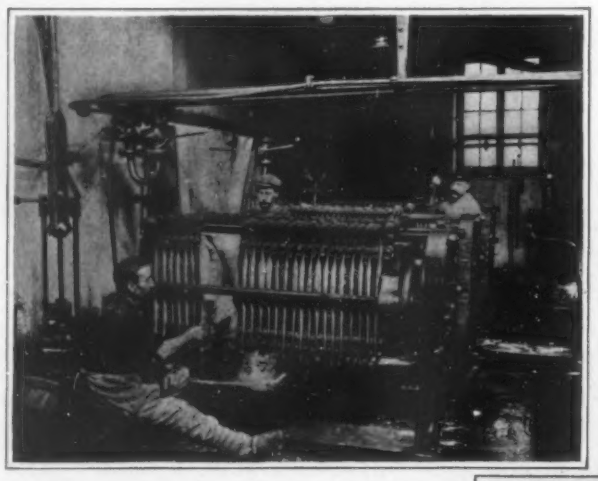
THE ferment used for raising the dough in making bread is a microscopic fungus, so-called yeast, or, as it is called by the biologist, saccharomyces cerevisiæ. This organism grows in saccharine liquids, reproducing by budding. Its cultivation constitutes quite an important industry, some of the essential steps of which, as carried out in France, are illustrated in the accompanying views. The raw materials in this industry are barley, rye, and Indian corn. The first operation consists in cleaning this material in special engines provided with metal brushes, sorters, and separators. After the dust and other adventitious material has been thus eliminated, a certain portion of the grain is passed through a mill and is ground to flour. The remainder of the barley is taken to another part of the plant, located in the basement, where the operation of malting and germinating is carried on. In the course of this process a certain ferment, known as diastase, is developed in the grain, which has the property of transforming starch into fermentable sugars. Throughout the malting operation it is necessary to observe careful precautions in regulating the temperature and humidity, as these factors exercise an important influence upon the proper course of the process. The temperature commonly employed is from 12 to 14 deg. Cent. The ordinary method of germinating the grain requires an extensive floor area and great attention on the part of the workmen, and is moreover applicable only at certain times of the year, for if the malting is carried on during the hot weather, there is apt to be a very serious development of mold. This last inconvenience has been very successfully overcome by the so-called pneumatic malting process introduced by Galland and others. This consists simply in circulating through the grain a current of air whose moisture and temperature is regulated according to atmospheric conditions and to the particular phase in the process. The wet barley is placed in double-walled sheet-iron drums or cylinders, through which the regulated air current is passed, while the grain is slowly turned over by rotating the drum about its geometric axis, for which purpose the cylinder is mounted upon four rollers, and is provided at one extremity with a toothed wheel engaging a worm gear. The cylinder rotates once in about forty minutes.



Rotary germinating drums.



The fermentation vats.

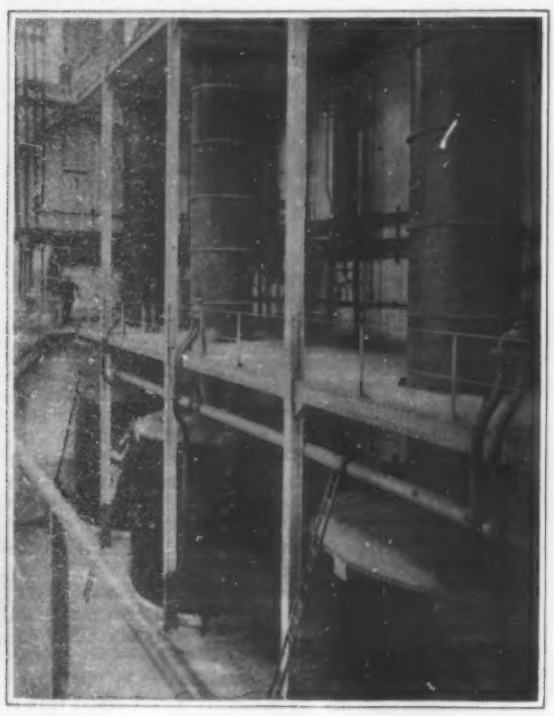


The filter press.

The charging and discharging is effected through a man-hole closed with a door, while a platform gives the foreman access to the drum and enables him to observe the progress of the operation. After some eight or nine days the germination is sufficiently advanced, and the diastase is fully developed. It is then necessary to stop the operation, for otherwise the young plant would continue to grow, giving rise to other changes than those which are the manufacturer's object. It is time to take the barley out of the malting drum and to proceed to the next operation, which consists in drying the grain at an elevated temperature. This is carried out in long rectangular rooms built of brickwork, and measuring about twenty-three by thirty-three feet in length and breadth, and about forty to fifty feet in height. In these hot rooms the barley is spread out upon sheets of metal gauze, in layers about four inches deep, and is allowed to dry gradually. A short chimney at the end of the building allows the escape of the water vapor liberated in the process of drying. After the drying operation is completed the grain is next passed on to a riddle, whereby the rootlets formed during the germination are broken and separated. The grain is next

(Continued on page 506.)

Packing the malt in bags.



The rectifying stills.

The distilling columns.

THE MANUFACTURE OF YEAST

Science

Preserving Hail-stones.—The peculiar formation of hail-stones and the probable conditions of their production have long been matters of much interest to scientists. A thorough study of them, it is believed, might throw much light on various meteorological phenomena, especially in regard to air-currents, changes of temperature and of pressure, etc., in the upper strata of the atmosphere. A comparison of them with the "ice flowers" and snow crystals or stars which Tyndall and other prominent scientists have found so fruitful a field of investigation might yield important results. Heretofore, however, the comparative rarity of their occurrence and the great rapidity with which they melt, has offered obstacles to this. But Prof. Boris Weinberg, of Tomsk, Siberia, has just perfected an apparatus, as we learn from *Les Annales*, which is expected to obviate these difficulties. He will gather the hail-stones as opportunity offers and preserve them by plunging them in a liquid of about the same density contained in a double-walled receptacle like a superior ice cream freezer, but "packed" with a mixture of ice and sulphate of copper. As needed for study the stones can be removed, sliced in extremely thin sections and photographed by a polarizing microscope or autochromatic plates, as is done with anatomical preparations.

The Eruption of Taal Volcano, in the Philippine Islands, which took place January 30th, 1911, and caused a loss of 1,300 lives, has been the subject of a large number of important papers in the scientific journals, besides the official reports of the Philippine Bureau of Science. One of the most graphic descriptions is that of Rev. M. Saderra Masó, which is published as a special bulletin of the Philippine Weather Bureau. This account is noteworthy for the attention devoted to the meteorological and seismological features of the eruption, and in this respect it is an important contribution to the science of vulcanology. This volcano has been the seat of repeated disastrous eruptions, the greatest of which was that of 1754. All the eruptions of which a record has been preserved have had the same character as the recent one, consisting of violent explosions which hurled the volcanic products to great distances. The huge vapor column of the last explosion rose to a height of from 20,000 to 30,000 feet, and was seen 250 miles away, where it was mistaken for a distant thunderstorm. One remarkable feature of the volcano is that no lava has ever issued from it in a liquid state, the ejecta being blown to dust and ashes by the pressure of gases or steam. The late eruption appears to have been marked by unusually magnificent displays of volcanic lightning. For three days preceding the eruption a constant succession of seismic shocks were felt over a wide area, and they caused much alarm in Manila, until the Weather Bureau located the epicenter in the region of the Taal Volcano. The partial vacuum produced at the moment of the explosion and the resulting diminution of atmospheric pressure set up strong winds blowing in toward the volcano. This wind was felt as far away as Manila (39 miles). At points nearer the volcano it assumed almost hurricane violence, impeding the movements of people who were trying to flee against it, producing tremendous waves on Lake Bombon, causing sheets of iron roofing to fly about, etc. At a distance of 14 miles Father Masó saw the cogon grass lying like wheat which had been beaten down by a storm. He is of the opinion that the wind assumed a rotary motion, in accordance with the general laws of storms, so as to produce a transient tornado or whirlwind. The atmospheric waves propagated outward from the volcano were recorded on biographs to a distance of 200 miles.

Engineering

Need for Navy Colliers.—The Navy Department has chartered six Scotch steamers and one American steamer to carry coal from Norfolk to San Francisco for the use of the Pacific fleet. The Scotch steamers will charge $5.40 a ton; the "J. M. Luckenbach," the only American vessel that competed, asked $8 a ton, which bid the navy accepted.

Test of a 21-inch Torpedo.—A torpedo designed for the navy, during a recent test in Sag Harbor by the Bliss-Leavitt Company, traversed more than ten thousand yards, when fired at a 32-knot speed. At 27 knots it covered a range of over 8,000 yards. Most of the torpedoes now carried by battleships and armored cruisers have a speed of 35 knots and a range of 5,000 yards.

Dynamite for Farming.—Experiments were recently made in New Jersey to demonstrate the efficacy of a low-freezing explosive in aerating the sub-soil and digging a hole for tree-planting. The discharge breaks up the adjacent ground and renders tenacious subsoil porous and sponge-like, thereby favoring a conservation of the moisture. It is claimed that a deeper root penetration becomes possible, and that the crops are not so sensitive to spells of dry, hot weather.

The Twenty-second Dreadnought.—The "Centurion," launched November 18th at Devonport, is the twenty-second dreadnought to be put afloat for the British navy. She will have a displacement of 23,500 tons, and a speed of 21 knots. The armament will consist of ten 13.5-inch guns and twenty-four 4-inch guns. Her armor on waterline and turrets will be 12 inches thick. She will have three torpedo tubes for the discharge of the new 21-inch torpedo whose effective range is 7,000 yards.

The 1000-foot Vessel.—A dispatch from London says that the White Star Line has ordered from Harland & Wolff a liner which will exceed the "Olympic" by one hundred feet in length. As this ship measures 882½ feet, it will be seen that the new vessel will be approximately one thousand feet long. Although the report lacks verification, it may well be true, although the question may be asked on this side of the Atlantic: "Where will she dock?" Even the White Star docks with their temporary lengthening of one hundred feet would not accommodate such a ship, whose stern would project over 80 feet into the North River.

Praise for American Shipyards.—United States shipbuilders recently were paid a flattering tribute by Admiral Garcia, of the Argentine navy. The Admiral recently made a close study of European shipyards in connection with the letting of the contracts for the two battleships which are being built respectively at the Fore River yard and at those of the New York Shipbuilding Company. He stated that in many points of equipment and management, our shipyards are decidedly superior to the most renowned shipyards of Europe—a statement which will not be surprising to those who are familiar with conditions in the best of our home yards.

Expert Testimony on "Olympic" Collision.—The recent summoning by the British Government of Naval Constructor P. W. Taylor, U.S.N., as an expert witness in the Admiralty trial in connection with the collision between the "Olympic" and the cruiser "Hawke," brings to mind tests made by Mr. Taylor in the model tank at Washington. These experiments with four models towed at different speeds and in various positions with regard to one another, show that one vessel overtaking another is repulsed by the forward vessel until an overlap of one-third has been established. Then there is a sudden change, the rear vessel being strongly drawn toward the leading vessel.

Aeronautics

Fowler's Flight Eastward Across the Continent.—After being stuck in the sand 15 miles west of El Paso, Texas, for eight days with his Wright biplane, on account of a balky engine, Aviator Fowler finally flew over the town and landed within it on November 13th. He expects to finish his trip *via* New Orleans and the Southern States.

Fight Aircraft with Mortars.—Recently the experiment was made at Sandy Hook of firing at aircraft with a 12-inch mortar, which proved that this was an effective weapon for the purpose. The mortar fired a shell filled with shrapnel, and the targets were a number of small captive balloons. The test proved very successful, even with balloons at high altitudes. Then a number of balloons were liberated, but even with free balloons the average of the hits was good. Experiments of this sort are soon to be conducted with aeroplanes as targets.

Bomb-dropping from Aeroplanes in Actual Warfare.—According to the latest report from Tripoli an Italian military aviator succeeded in dropping four bombs into the Turkish encampment on November 1st. The bombs, which contained picric acid, exploded, and a few hours later an aerial reconnoiter showed the Turks had vacated the spot. Flying over the desert is quite similar to flying over the sea, according to the experience of the Italian aviators; but while at a height of 1,000 feet a fine view is obtained, if the aviator ascends 300 feet farther even, the earth is generally concealed by a blanket of fog. It is therefore difficult to reconnoiter at a safe elevation. The aviator who dropped the bombs also found it difficult to determine what damage had been done. It is therefore suggested that a second aeroplane should follow with an observer who can keep the pilot of the first aeroplane informed as to the havoc he is creating.

An American Wins French Military Aeroplane Tests.—As forecasted in the article on the French military tests, Charles T. Weymann, with his Nieuport monoplane, won the 186-mile cross-country race. He covered this distance in 2½ hours as against 3¼ hours required by Prevost on a Deperdussin monoplane, which also was propelled by a 100-horse-power Gnome motor. Weymann's Nieuport weighed 483 kilogrammes (1,065 pounds) and carried as much again in live load and ballast. Thus over a ton was driven through the air at a speed of 72½ miles an hour for a distance as great as from New York to Philadelphia and back. The fact that Weymann carrying so much weight averaged nearly as much as he did with a stripped machine in the International Cup race on July 1st last, is another proof of the small head resistance of the marvelous Nieuport monoplane.

Orville Wright's Flights in a Glider at Kitty Hawk.—Upon his return home from his memorable flights without a motor at Kitty Hawk, N. C.—flights in which he remained aloft 7¼ and 9¾ minutes, respectively—Orville Wright said that these motorless flights were the most difficult he had ever undertaken, the conditions under which they were made being much more severe than those ever met with in a power-driven aeroplane. Measured with a Richard anemometer, the wind one day at the top of the hill had a velocity of from 17 to 25 meters per second (38 to 56 miles per hour), while 12 feet above the top of the hill the wind velocity was still greater. There was a difference of 5 meters per second in simultaneous observations made at heights of 6 and 12 feet, respectively. Mr. Wright believes his experience at Kitty Hawk will be of great assistance in designing new machines to meet severe weather conditions.

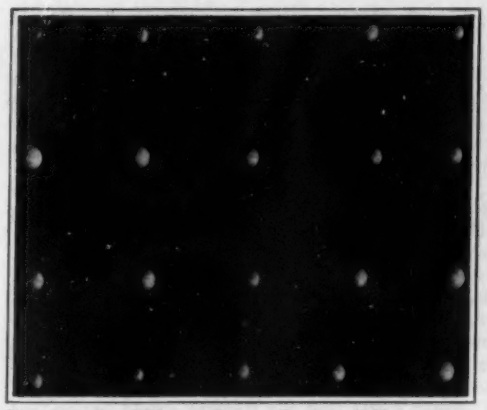
The Latest Photograph of the Planet Mars

By Mary Proctor

DR. PERCIVAL LOWELL, of the Lowell Observatory at Flagstaff, Ariz., has been finally successful in obtaining photographs of Mars, which establish beyond a doubt the reality of the canals of Mars. Heretofore, the value of the photos obtained by him in 1907 was questioned, on account of their minuteness, being compared in size to the head of an ordinary pin. Doubts were expressed as to the amount of detail which could be seen on so small a scale, and magnification, it was said, only increased the difficulty by enlarging the silver particles upon the plate, wherever its sensitive surface had been exposed to the light.

With regard to photographs of Mars obtained October 11th, 1911, with the Lowell refractor, 24 inches aperture, the images made at one minute intervals of exposure, each of three seconds, Dr. Lowell writes as follows, in a letter dated November 9th, 1911:

"The following, therefore, will interest you and the public generally—the magnification used for the photographs is now 178 diameters. This on a disk of twenty-four seconds of arc which Mars presented at the last opposition gives for the photographic images a diameter 2.3 times that of the Moon to the naked eye, and a superficies of over five times that presented by our satellite to naked eye vision—rather a surprising revelation this as to the size of our photographs.



Photographs of Mars, taken at the Lowell Observatory by Mr. E. C, Silpher on October 11th, 1911.

"Believe me, yours very truly,

"(Signed) PERCIVAL LOWELL."

The diameter of Mars at the last opposition was twenty-four seconds of arc less than now. Superficies, in the above letter, means surface of original photographic images which then covered an area over five times that presented by the full Moon to the naked eye, the telescope magnifying one hundred and seventy-eight diameters. While the canals are plainly visible on the photographic plate, they will not bear printing processes. On examining the enlarged image through a screen by a stereopticon an immense amount of elaborate detail appeared, several of the canals being plainly in evidence. As these photographs were taken a month or so before Mars had reached its nearest to our planet, we may look forward with interest to those which will be obtained on the date of nearest approach.

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them

Family Likeness in Handwriting

SOME of our readers may have amused themselves with the hobby of reading character from a person's handwriting. The indications thus obtained may perhaps also be applied for serious purposes. If a person's writing discloses his character, and if individuals of the same family resemble one another in their characters, we must expect to find that there will be a resemblance shown in their handwriting also. That this is indeed the case is shown very clearly in a number of examples illustrated by R. H. Chandler in *Knowledge* and reproduced here. Perhaps the most striking case of general resemblance is the handwriting of two sisters which is reproduced in Fig. 1. Note especially the formation of the word "the," which

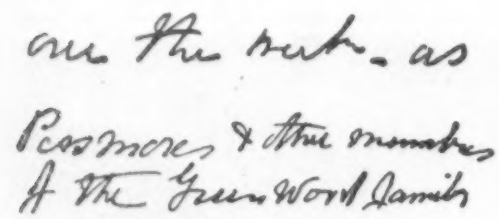


Fig. 1.—Handwriting of two sisters.

is almost identical in the two cases. Somewhat similar remarks might be applied to the cases shown in Figs. 2 and 3, while the resemblance of the characters

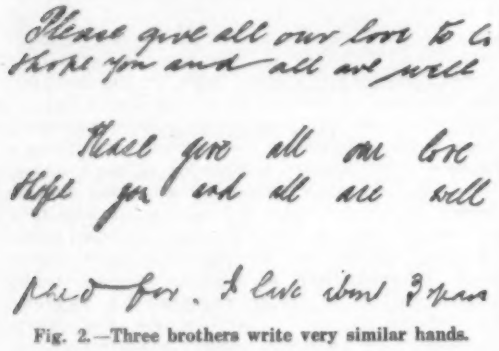


Fig. 2.—Three brothers write very similar hands.

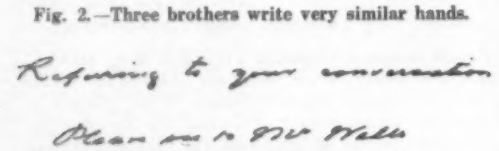


Fig. 3.—The writings of these two brothers are almost undistinguishable.

shown in Fig. 4 is less obvious, but is really most striking when we examine into details. Note for example the peculiar method that both father and son follow in lifting their pen in writing the word Belvedere. Each makes an entirely separate act of writing the "e" in the middle of this word. Another feature common to both writings is that the letters increase in size toward the end of each word. This is especially marked in the first example, the father's writing.

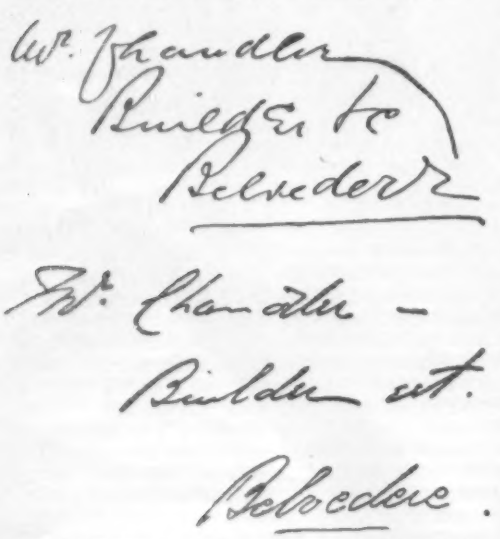


Fig. 4.—Father and son. The resemblance here is in details rather than in general form.

Motor Trucks for Mines.

MR. H. M. BEATSON, writing in *The Engineering and Mining Journal*, draws attention to the utility of automobile ore trucks at mines where ore is hauled by wagon to mill, smeltery or railroad shipping station: "There should be a demand for such trucks just as soon as wagons suitable for hauling ore are placed on the market. The automobile truck is a comparatively recent development. It is still hardly beyond the experimental stage, but it already gives promise of hauling ore at a smaller cost than such work can be done by teams.

"At some mines traction engines have been used for hauling a string of wagons. Where the roads were comparatively level and in good condition, they proved to be satisfactory, but the traction engine is too heavy in proportion to its tractive power to do the work that could be expected from the lighter gasoline-motor truck. The traction engine sinks deeply into soft ground, cannot readily run on steep grades, and is too heavy to safely cross the wooden bridges that are so frequently used to carry a road across a stream. The motor truck is free from most of these defects, but in order to pull a number of wagons in one train some special provision will have to be made to control the trailers on steep grades.

"This has been the object in view of a German manufacturing company that has recently built a road train in which the lightness of the gas-motor truck is combined with the advantages of a traction engine for pulling a number of wagons. The train consists of a generator wagon and six trailing motor wagons, each of which is capable of transporting five tons at a speed of seven to ten miles per hour. The two gasoline motors drive two electric generators. For each axle of all the wagons there is one driving motor. Steering is effected from the driver's wagon, and the provision of suitable shafting between the trailers causes them to follow the bends or curves in the road taken by the generating wagon.

"It is said that these trains can travel readily over rough ground; that the wheels, which are fitted with broad tires, do not sink into sandy soil. The weight is better distributed and is less than that of a traction engine of equal power."

The Workman's Attitude Toward the Machine

IN a recent number of *Die Umschau*, under the heading "What the Workman Thinks of the Machine," F. Müller gives an account of impressions gathered by him regarding the place which machinery occupies in the mind and life of the workman. The method which the author has adopted to obtain his material is to approach a large number of workmen, requesting them to express their views to him by letter. He quotes passages from a number of such letters, from which a few excerpts are given below.

An umbrella maker writes: "For the last twenty-two years I have had my post at a special machine for making umbrella ribs. There are hundreds of members and joints working at a time. The eye finds it quite impossible to follow all the motions. The first impression which the machine made upon me was one of admiration, coupled with a certain dread. I believe men would be better off if there were not so many machines in use. My machine can hardly be said to be dangerous, unless a man commits some act of extreme negligence. In such case it is true that I have known one of my own fellow workers to have his hand crushed into a shapeless mass. I shall never forget the sight. Such accidents harden a man and seem to turn him into a machine himself."

Another writes: "If an accident has occurred in the works, it often affects a workman in such a way that he becomes extremely nervous and excitable. At every chance outcry, made perhaps in jest by some one of his fellows, he imagines that some one has been caught in the machine. The accident will torture such a man in his sleep, from which he will wake up with a start in the grip of a horrible nightmare."

A glass maker in Düsseldorf, who has been at his work for thirty-two years, makes the following thoughtful observation: "I am of the opinion that a man attending a machine cannot follow up an idealistic train of thought, but becomes deadened in his sensibilities. On the contrary, in the pursuit of some congenial manual labor, such as glass making was until recently, he has an opportunity to do this. There is a peculiar charm in watching a gang of men working at the tank furnace and singing at their work. It seems a pity that the machine should put an end to all this. In the machine room there is always a certain depression. My opinion is, living for a prolonged period with the machine means a slow dying of a man's higher instincts."

Another workman remarks: "It is found that machine attendants are much more irritable and much more easily given to anger than manual laborers."

This complaint of the strain upon the nerves and the ill effect upon the man's temperament occurs in almost all the letters published by the author; in many, too, is found the statement that the workman's sleep is disturbed by evil dreams about accidents. One man says: "I believe that we should be much happier without the machines, and that there would be three-quarters less cripples in our population than under present conditions." This statement may, perhaps, be thought exaggerated, and is here quoted for what it is worth. Nevertheless, it evidently represents a common impression among workmen, for close upon it we find an observation by another workman, who says that "of four hundred and fifty machinists on wood-working machines in Munich, there are not ten men who still possess their ten fingers."

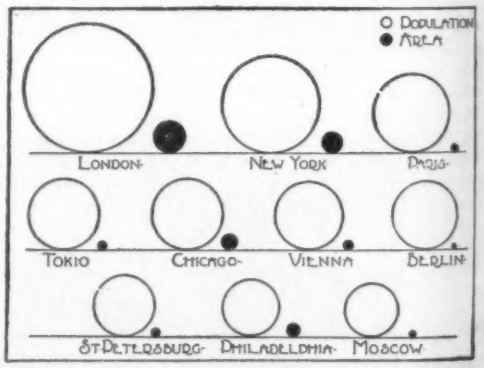
While it appears probable that the workmen's estimates may in some cases be exaggerated, through their natural horror at some of the terrible accidents witnessed by them, the mere fact that this impression exists is sufficient to command our very thoughtful and sympathetic attention.

The Great Cities

SOME interesting facts relating to the population statistics of the world's great cities are cited by Prof. W. B. Bailey in the *Independent*:

There are at present ten cities in the world with a population of over 1,000,000. Of these, three are in the United States. Russia is the only other country to have more than one city of this size.

London leads with a population of over 7,000,000; but its area is over 440,000 acres. The area of Greater New York is less than half that of London. If New York city could annex enough of its suburbs to make its area equal to that of London, it would at present have a population of over 6,000,000. Even without annexing any more territory, New York may, within twenty years, become the greatest city in the world. If it were possible to include suburbs, as has been done by London, it might become the leader within ten years. The area of Registration London, not including the outer ring, is 74,839 acres. On this territory is found a population of nearly 5,000,000, but within the past decade the population of the old city of London has actually decreased. Business is crowding residences from the center.



Diagrammatic representation of the population and area of the world's greatest cities.

Berlin has recently annexed suburbs with a population of nearly 1,000,000. It seems likely that when figures are available it will be discovered that Berlin has displaced Paris as the third city in the world. The following are the population and area of the ten largest cities in the world at the latest date for which figures are available:

City.	Area in Acres.	Population.
London	441,600	7,252,963
New York	209,218	4,766,883
Paris	19,280	2,763,393
Tokio	27,989	2,186,079
Chicago	117,447	2,185,283
Vienna	39,686	2,085,889
Berlin	15,698	2,070,695
St. Petersburg	22,991	1,678,000
Philadelphia	81,828	1,549,008
Moscow	17,654	1,359,254

Suggestions for the Workshop

Ingenious Expedients of Resourceful Mechanics

A Secret Lock for a Cabinet Door

By William J. Horner

THE method of locking shown in the illustrations is suitable for secret doors or panels which are not supposed to open, or it may be used on hinged cupboard or cabinet doors in addition to or in the absence of an ordinary lock. The principle is that of an inside latch or bolt operated by a knife blade, or similar thin instrument, put through a crack between the door and its framework. If a crack for this purpose is undesirable it would be easy with a little ingenuity to work the bolts by a string or wire carried to a convenient point away from the door. Although the method of operating the lock may give the idea that it is an insecure and weak fastening, it actually may be very strong indeed, for the strength of a lock

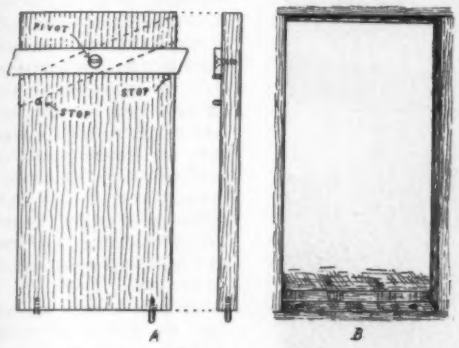


Fig. 1.—Panel with swivel cross bar.

does not depend on the size or character of the key which opens it.

Fig. 1 shows a panel or cover and the opening into which it fits. A swiveling cross bar is pivoted to the inside face of the panel. When in the horizontal position the ends of the bar project and fit either behind adjoining panels or into slots, and the panel is locked in place. When the bar is swung into the position shown by the dotted lines its ends are flush with the edges of the panel. Stops are inserted as shown to permit only just the amount of swing required. The lower end of the panel has fixed pins or dowels to secure it, or the wood may be tongued or rebated. Screws with their heads filed off make good pins. Shoulders are necessary in the opening to prevent the panel from being forced inwards, and when it is locked it should be tight. If desirable nail heads

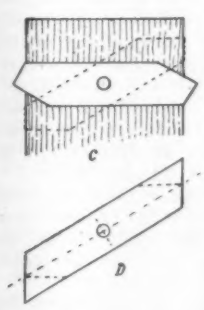


Fig. 2.—Modified form of cross bar.

Fig. 3.—Door with short fastenings.

may be driven in at each end to give it the appearance of being nailed in place.

The cross bar shown in Fig. 2 is a neater shape than the simpler form in Fig. 1. Its ends are cut so that the points are central instead of being at opposite edges of the bar. Besides this it will be seen in the dotted position that the portion cut from the highest part gives a horizontal edge which can be set to just clear the shoulder against which the panel beds and so the center of the bar can be slightly nearer the end of the panel. The way the bar is marked out is apparent at *D*. It may be of wood or metal.

So far the examples show bars running across the panel and securing it on both sides. Fig. 3 shows a hinged door with short fastenings at the side which opens. They are pivoted midway of their length so that they will balance. The dotted vertical pieces which cross them are guides which act both as stops and relieve the central screw from strain if an attempt is made to pry the door open.

Unless the panel is very narrow these would be necessary in Figs. 1 and 2. The stops shown in Fig. 1 are suitable where little strength is required but if the panel is forced outward the bar, secured only at

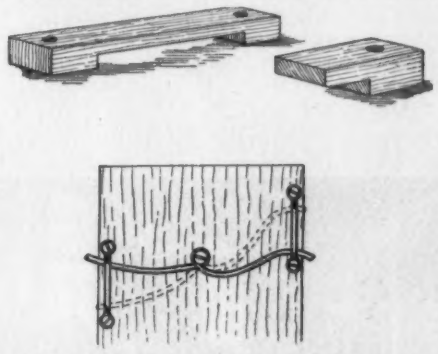


Fig. 4.—Wooden guides and wire fastening.

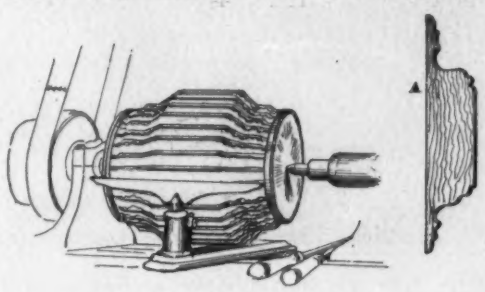
the center, may break or bend and the screw be loosened. Combined guides and stops, as shown in Fig. 4, screwed to the door close to the edge, prevent this and greatly strengthen the fastening. The double-ended guide in Fig. 4 stops the bar in each direction and keeps it close to the door surface. The single one is intended for use where there is not room for the longer one. It would be suitable for stopping against the lower edges of the bars in Figs. 1 and 2, at the right-hand sides, where, in the dotted position, there is no room above the bar for attaching a double stop and guide.

Fig. 4 also shows a fastening on the same principle made of wire instead of wood. The wire is bent to a curve so that its ends project nearly at right angles in all positions of its travel. If it was straight and consequently at right angles in one position and sloping in the other a knife would not work it so easily. Moreover when bent its extension can be adjusted exactly as required by further bending.

Turning Duplicate Forms

By Albert F. Bishop

A WOODWORKING firm received an order for several hundred brackets which naturally would be sawed on the jig saw. The party ordering the brackets stated that they must be perfectly smooth on the sawed edges. The sawyer knew at once that if each piece was sand-papered by hand on the edges, the extra time required would greatly delay the work. His fellow workman, a wood turner, said he could make the pieces in a lathe. This is how he did it: He took a log of wood for a hub, and with a wobble saw cut longitudinal grooves in it to receive the



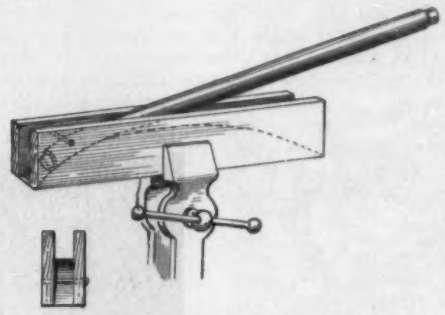
Making duplicate brackets on a lathe.

bracket pieces. These were previously cut a trifle long, leaving a little tip on each end to be clamped by the iron bands that were put on each end of the hub. The whole thing was placed in the wood lathe and turned by hand like the pattern marked *A*. The sand-papering and polishing came next, which made the forms absolutely smooth and gave them a nice finish. In doing work by this method care was taken to fit the pieces nicely so as to prevent chattering and slivering on the sides.

Bending a Brass Tube

By A. F. Clark

IN the issue of May 6th is described a process for bending brass tubing. The following is a much simpler method where a coil spring long enough and of the proper size is not available. Plug one end of the tube with a piece of wood and then stand it on end and fill it with dry sand. Tamp the sand firmly by striking the plugged end on a block of wood. When the tube is full plug the other end also with wood, then take a piece of hard wood as thick as the outside diameter of tube and saw it to the shape you wish to bend the tube; then nail two other pieces of wood,

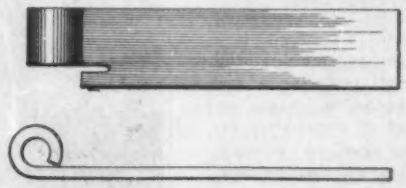


Method of bending a brass tube.

one on either side of the form. Clamp the whole firmly in a vise as shown in the sketch. Then drive a nail through the two outer pieces near one end of the form under which insert the end of the tube, after placing a small piece of flat iron or a chisel between the nail and the tube. The two outside pieces are necessary as all tubing has a tendency to flatten while being bent. After the tube is bent the wooden plugs can be easily removed by inserting a wood screw into them and, after warming the end of the tube, using the screw as a handle to pull out.

Guide for Winding Coil Springs

THE accompanying illustration shows a small tool which will be found useful for winding coil springs in a lathe. It is made of a piece of three-sixteenth-inch sheet steel, one end of which is turned over to fit the arbor on which the spring is to be wound. A slot is cut in the tool near the arbor bearing, to serve as a



Guide for winding coil springs.

guide while winding the spring. The tool is placed on the arbor and the latter is centered in the lathe. One end of the wire is fastened in a hole drilled in the arbor and then, by passing the wire through the slot, it will be guided as the arbor is turned, to make a uniform spring.

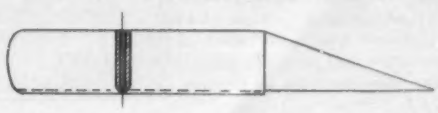
Grinding Copper.—When it is desired to grind copper on a carborundum wheel the copper invariably clogs. By rubbing on tallow this is prevented and apparently the tallow does not interfere with the cutting of the wheel.—B. F.

Knife Made from a Hacksaw Blade

By H. M. Nichols

THE steel used in hacksaw blades is well adapted for making knives, as it can be ground to a good keen edge that stands up well under usage.

The knife shown in the illustration was made from a hack saw blade ¾ inch wide and about 1/16 inch thick. The blade part was ground off on an angle, as shown, and the handle was formed by bending a piece of sheet zinc in the form of a U over the back of the blade. Of course a more pretentious handle



Hacksaw knife.

could be made from wood, held in place with rivets, but the handle described answers the purpose very well and has the merit of being made quickly. The blade is ground like an ordinary knife blade, or it can be ground on one side only like a chisel. If used for a scratch knife the latter method of grinding it preferred by the writer.

The First National Mine-Safety Demonstration

Study of a Real Mine Explosion

By Charles L. Wright, Fuel Engineer, Bureau of Mines

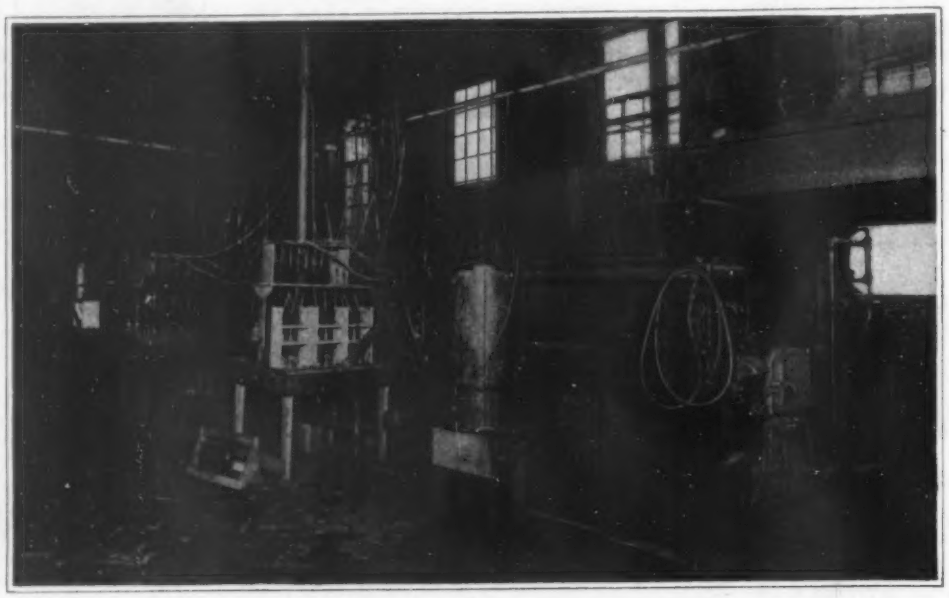
THE work that is being done by the Government to reduce the dangers of mining was brought out strikingly in the First National Mine-Safety Demonstration which occurred at Pittsburgh, Pa., on October 30th and 31st, under the auspices of the United States Bureau of Mines with the assistance of the American National Red Cross Society and the Pittsburgh Coal Operators' Association.

The work of the explosive testing section was exhibited in a spectacular manner in the gas and dust gallery which is a steel tube 100 feet long and 6½ feet in diameter open at one end and closed at the other, with the exception of a small hole through which it is fired by the flame from a small cannon charged with the explosive that is being tested. The gallery is provided with explosion doors on top which are raised by the force of the explosion, and windows of heavy glass on the sides through which flame is visible when an explosion of gas or dust is produced. A portion of the tube was partitioned off by heavy paper making a chamber in which gas and air were mixed so that the mixture contained seven per cent of methane and ethane, both explosive gases. A charge of black blasting powder equal in strength to one-half pound of forty per cent nitro-glycerine dynamite was fired into the gallery igniting the gas and producing a terrific explosion. Again, an amount of permissible explosive equal in strength to the black blasting powder was fired in a gaseous mixture of the same composition. As no explosion of the gas took place, the relative safety of black blasting powder and permissible explosive was evident. This test of explosives is especially valuable in gaseous mines where there is the liability that the flame from the explosive may ignite pockets of gas which may be present near where coal is being blasted out.

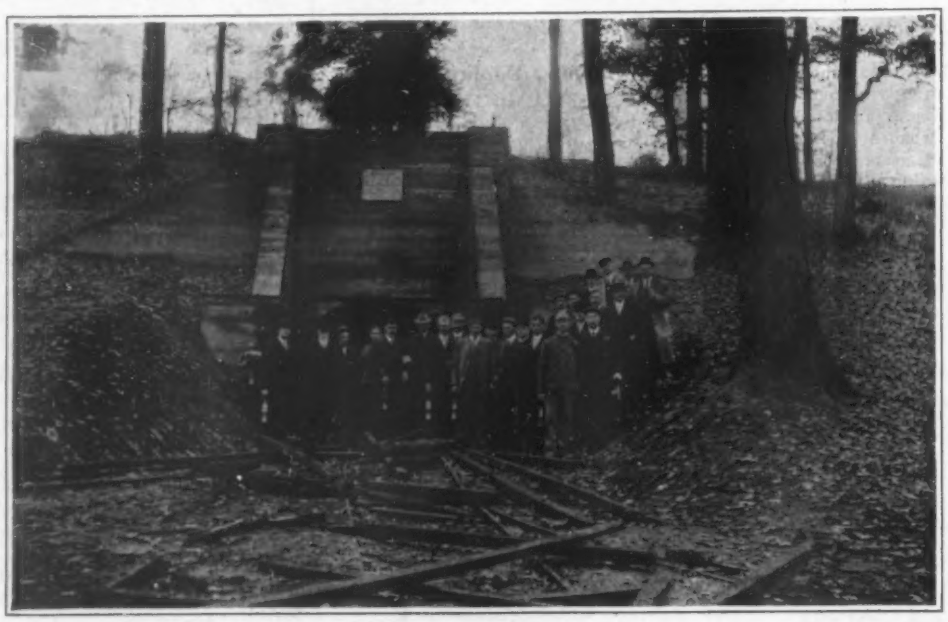
In another building lighted incandescent lamps were broken in an explosive mixture of gas and air illustrating the relative safety of lamps of different candle power when operated with different voltages. In still another building a foundry cupola was in operation to show the method of taking gas samples and temperatures in various zones of the coke bed for the purpose of studying the fundamental principles of the process with a view to possible improvement. A gas producer was in operation burning fuel at a high temperature and capacity and in which the ash and clinker were removed by tapping off the liquid slag at stated intervals.

In the fuel briquetting plant two types of briquetting presses were in operation one of which was producing briquets from California lignite under a pressure of 20,000 pounds to the square inch without the use of artificial binder while the other machine made briquets of ordinary bituminous slack using six per cent of water-gas pitch as a binder. These briquetting experiments have for their object the better utilization of fuel waste and low grade fuels.

The long combustion chamber of the bureau was also interesting to many of the visitors. This is essentially a Murphy stoker at one end of a long chamber built of brick and lined with fire brick at the other end of which is a water tube boiler. At several points on this chamber there are openings for the insertion of thermo-couples and the withdrawal of samples of flue gas. A large number of gas samples are taken from the various points simultaneously and the study of the analyses of these samples makes it possible to determine the proper distance that the furnace should be from the cold boiler tubes in order that complete combustion may take place. This distance varies with different types of fuels and the results of these investigations will undoubtedly furnish valuable data for designers of boilers and furnaces.



Long combustion chamber, showing apparatus for testing samples of gases at various points.



Entrance of the mine after the explosion. Note the debris.

THE FIRST NATIONAL MINE-SAFETY DEMONSTRATION

Another feature of the demonstration was a safety lamp test. Single and double gauze safety lamps were placed in a testing apparatus where they were subjected to currents of air of a known velocity containing eight per cent of methane and ethane. The lamps which were safe to use did not produce an explosion of this mixture of gas and air; others did, and thus their relative safety was demonstrated.

Men in various types of breathing apparatus were exercising in a room filled with a noxious atmosphere and a glass partition permitted the visitors to see in a graphic manner how operations are carried on by the rescue corps under conditions similar to those existing after an explosion has occurred in a mine.

There was also an exhibition of apparatus for the physical testing of explosives including a ballistic pendulum by means of which the relative disruptive force of an explosive is determined; a pressure gage for determining the pressure developed by a known weight of an explosive; a calorimeter for determining the heat of combustion of an explosive; a flame testing apparatus for the determination of length and duration of the flame of an explosive, an apparatus for determining the rate of detonation of an explosive, a large and small impact machine for determining the force necessary to set off explosives. Trauzl and lead blocks which are also used for determining the relative power of an explosive and a cone and pendulum friction device for determining the behavior of explosives under friction.

The explosibility of coal dust was shown by means of a laboratory coal dust ignition apparatus consisting of a heavy glass vessel into the bottom of which coal dust was blown by air upon a wire heated red hot by an electric current. The force of the explosion of the coal was graphically shown by the bursting of a thin glass flask connected to the top of the ignition apparatus.

In gas and dust gallery No. 2 an inclosed electric mine motor was shown operating in an explosive mixture of gas and air without producing an explosion. Later the protecting devices were removed from this motor and an explosion of the gaseous mixture resulted. The relative safety of motors for mining purposes under the two conditions open and protected were thus demonstrated.

Two of the mine rescue cars of the Bureau were on the siding at the plant and open for the inspection of visitors.

In the afternoon of the first day the experimental mine of the bureau was visited by a party of about two thousand people, a special train being provided. The trip to the experimental mine was made for the purpose of seeing a demonstration of the explosibility of coal dust in a real mine. The mine is located in Bruceton, Pa., in the Pittsburgh seam of coal which at this point outcrops on the side of a hill about 100 feet above the railroad. The mine was opened primarily in order to study the principles involved in dust and gas explosions and to test various methods of preventing and checking explosions in progress under actual mine conditions. When the special train arrived at the station the rain was falling steadily, but this was not sufficient to dampen the ardor of the enthusiastic visitors including several ladies. As soon as the party had climbed the steep ascent from the railroad to the mine they were invited to walk through the mine and 1,131 persons by actual count availed themselves of this opportunity. When all of the party were out of the mine again they were requested to take positions about twenty-five yards up the hillside above the mine

to await the explosion. Between 600 and 700 pounds of coal dust had been scattered along 600 feet of the main entry which is 750 feet long and two pounds of black powder were placed in a drill hole at the extreme inner end of the main entry in such a manner that the conditions would represent those similar to a blown-out shot in actual mining. Electric wires connected this charge of explosive with the instrument house outside of the mine. The wires were placed in circuit with a source of electric current and the powder explosion which followed ignited the coal dust in the mine resulting in a terrific explosion. It was dark by the time that the explosion occurred and the smoke and flame mounted high into the air above the entrances to the mine. The air was filled with pieces of stone, broken concrete and wood and the people involuntarily took refuge under the trees. There was no real danger, however, as the people were above and back of the mine entrances. The force of the explosion was manifested in the vicinity of the mine by the damage done. Near the main entry a loaded mine car had been shot back about fifty feet while another partly loaded had been blown more than one hundred yards over a bank into the valley. The big bags of sand which were used in the brattices 130 feet from the entry had been blown out into the open. The temporary fan house had been wrecked and the office building partly demolished. If any of the mining men present had any doubt as to the explosibility of coal dust in a mine without the presence of gas, this question was settled once and for all.

It had been planned to have men equipped with oxygen helmets enter the mine immediately after the explosion to take gas samples, extinguish incipient fires and inspect the condition of the roof, but the lateness of the hour made it necessary for all to hasten to the train waiting to convey them back to Pittsburgh.

Every one who saw this demonstration was profoundly impressed with the importance of the test and many compliments were given to Director Holmes and those in charge of the experiment.

On the morning of the 31st the great first-aid meet and mine safety demonstration was held at Forbes Field. The first thing on the program was the first-aid exhibition. The forty teams that participated were arranged in a row facing the seats. While many of the teams participating came from Pennsylvania and adjoining States, there were others which came from longer distances notably those from Tacoma, Washington, Dawson, and New Mexico. The teams performed alternately in two sections, the even numbered teams working the same problems while the odd numbered teams worked other problems. The first-aid problems performed included treatment of lacerated wounds on the head and body, the treatment of fractured bones and dislocated joints, the removal of a man from an electric wire and the treatment of gas and electrical burns.

A coal dust explosion in the gallery at Forbes.

Helmet men entering the gallery after the explosion.

Rescue squad bearing an injured man.

THE FIRST NATIONAL MINE-SAFETY DEMONSTRATION.

Following the first-aid work a demonstration of the behavior of a permissible explosive in the presence of coal dust was made in a temporary steel gallery or cylinder 133 feet long and 6 feet 4 inches in diameter. The amount of explosive used was equal in disruptive force to one-half pound of forty per cent nitro-glycerine dynamite. The explosive was fired into the gallery from a cannon through a small opening in the steel end of the former. The other end was open to the atmosphere. One hundred and thirty-three pounds of coal dust was distributed uniformly throughout the explosion gallery and twenty pounds of dust was placed on a wooden bench twenty feet long near the mouth of the cannon making a total of 153 pounds of coal dust. When all was ready the charge was fired from a distance through wires by means of a storage battery. No explosion of the coal dust was produced by this test which demonstrated the safety of using a permissible explosive in the presence of dust. A second demonstration was made in the same gallery with the same amount of coal dust using a charge of FFF black blasting powder equal in disruptive force to the permissible explosive used in the previous test. When this black blasting powder was ignited from a distance a tremendous explosion took place, the flame escaped from the safety doors on top of the cylinder and great clouds of dust and smoke were blown out of the end of the gallery.

Immediately following this explosion while the gases within the gallery were still unbreathable a rescue party of foremen miners of the Bureau of Mines aided by squads from some of the visiting first-aid teams and all of them equipped with various types of breathing apparatus, entered the gallery and recovered several supposed victims of the mine explosion bringing them from the explosion gallery and placing them in the care of squads of foremen miners and first-aid miners of the Bureau of Mines who demonstrated the various first-aid problems using the pocket first-aid packet only and such things as might be handy in a mine after an explosion.

Another interesting feature of the exhibition was the mine gas test made with the use of birds in exploring mines after explosions or mine fires at which carbon monoxide causes a large percentage of fatalities. Birds are much more sensitive to the effects of this poisonous gas (carbon monoxide), than human beings, and when birds taken with a rescue party into a mine, show signs of distress, the party (which of course is supposed to be without oxygen helmets), will ordinarily have time to retreat to safety. At Forbes Field the practicability of this test was demonstrated by a gas chemist of the bureau who entered a glass box about 2 feet wide by 5 feet long, and 6 feet high, with canaries in cages. The atmosphere of the box contained one quarter of one per cent of carbon monoxide gas (the miner's white damp). In eight minutes three of the birds were overcome and collapsed completely.

The Heavens in December, 1911

By Henry Norris Russell, Ph.D.

WE had occasion not long ago to speak of the interesting observation of Prof. Stebbins of the University of Illinois, who devotes his time to making very accurate measures of the brightness of the stars, with an apparatus depending upon the change in the electrical resistance of selenium when light falls on it. Not content with the study of known variable stars, Prof. Stebbins has taken up the work of discovery, with conspicuous success, finding two new variables in the first two stars observed.

As, on the average, perhaps one star in a hundred, at most, varies in brightness, some principle must have guided such a successful search.

Spectroscopic observation tells us that many bright stars are really close doubles, far too near together to be separated by the most powerful telescopes, but revealed by the approach or recession of the star as it swings in its orbit about the center of gravity of itself and a companion.

In a few cases, such as Algol, the faint and relatively dark companion comes in front of the brighter star at every revolution and eclipses most of its light, causing conspicuous changes of its apparent brightness.

The amount of light variation in such a case obviously depends on the character of the eclipse. If the companion passes almost squarely in front of the primary, it will eclipse the greater part of its area, and, indeed, may completely hide it if, as often happens, the former star is the larger. But if it passes apparently to one side of the brighter star, and, even at most, covers up but a small portion of the latter, only a little light will be lost by the eclipse, and the apparent variation will be small, and can be detected only by very accurate measures.

Observing the brightness of selected spectroscopic binaries of this sort, Prof. Stebbins has found that the bright stars Beta Aurigæ and Delta Orionis are eclipsing variables of the type just described. He defers full discussion of the latter until more observations have been secured; but his conclusions regarding the former are presented in definite form.

Beta Aurigæ was one of the first spectroscopic binaries discovered. Careful study by several observers has shown that the system consists of two stars of very nearly equal mass and brightness, revolving at equal distances on opposite sides of their common center of gravity, in a circular orbit, within a period of about an hour less than four days. Prof. Stebbins finds that, just at the times when, according to the spectroscopic data, either star ought to be in front of the other, the apparent brightness of the system diminishes by about 7 per cent. This shows that a partial eclipse takes place, one star covering up about one-seventh of the other, cutting off that fraction of its length, and hence one-fourteenth of the total light of the pair. These eclipses last a little less than six hours.

Between the eclipses the brightness of the star is not perfectly constant, but increases by about 1 per cent until the time half-way between eclipses, and then falls again to its original value, just before the next eclipse. This may be explained by assuming that the mutual attraction of the two stars causes them to be slightly elongated toward one another, like two eggs with their narrow ends pointing at each other. When the stars are just out of eclipse, we see them end on.

A day later, midway between eclipses, they are broadside on, and look correspondingly brighter. The amount of this elongation is, however, only 1 per cent of the whole diameter, which could hardly be detected on a drawing to scale. From the length and depth of the eclipses, it is possible to find the inclination of the orbit plane, and the diameters of the two stars, in terms of that of the orbit. The spectroscopic observations then furnish us with a reliable scale of miles, and enable us to calculate the actual dimensions and mass of the system. What is more, in this case the parallax of the star is fairly well determined, both by direct measures and because it belongs to the group of stars moving together in space, of which the principal stars in Ursa Major are members. He can, therefore, compute the actual brightness of the stars, compared with the sun.

Combining all these facts, we reach a knowledge of the system more extensive than we at present possess for any other star. We may summarize it as follows:

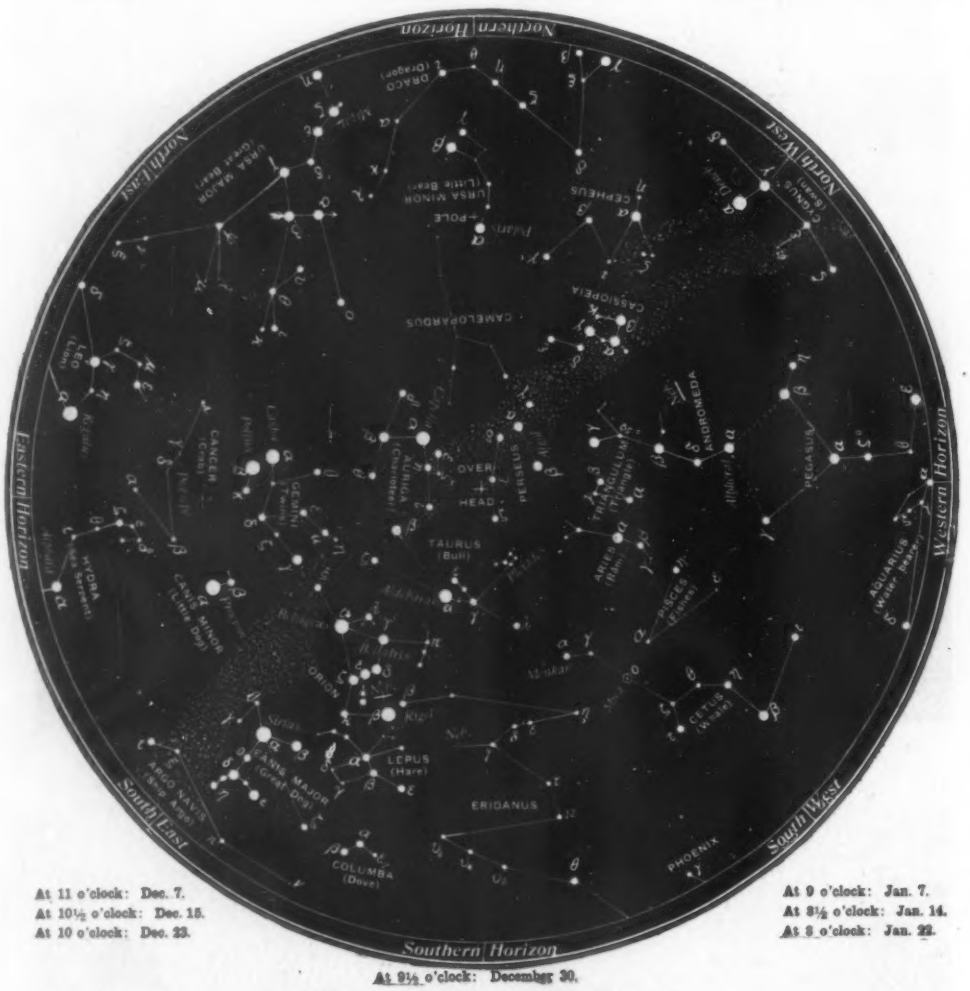
Beta Aurigæ consists of a pair of stars of equal size and brightness and very nearly equal mass, which revolve about their common center of growth in circular orbits lying in a plane inclined 12 degrees 49 minutes to the line of sight, with a period of 3 days 23 hours 2 minutes and 30 seconds, and mutually eclipse one another at every revolution. The two stars are elongated toward one another by their mutual attraction to the extent of 1 per cent of their diameters, and, owing to the influence of the tides raised by each on the other, the period of revolution is increasing by seven-eighths of a second every year.

The actual distance between the centers of the two stars is 7,630,000 miles, and each star is 2,200,000 miles in diameter. The more massive component has 2.38 times the mass of our sun, and the other 2.34 times.

The whole system is at a distance of about ten million times that of the sun—so great that light takes 160 years to travel over it. Each of the two stars gives out about 130 times as much light as our sun, from a superficial area a little less than seven times as great, so that per square mile, these stars send out nearly twenty times as much light as does the sun.

The sun itself, if in front of one of them, would appear as a rather small and very dark spot on the star's surface.

Though there is no other individual star about which we know nearly as much as this, it is probable, from various lines of evidence, that Beta Aurigæ is a fairly good representative of a considerable class of the brighter stars—which emphasizes the fact that our mighty sun is, after all, one of the smaller members of the host of heaven.



At 11 o'clock: Dec. 7.
At 10½ o'clock: Dec. 15.
At 10 o'clock: Dec. 23.

At 9 o'clock: Jan. 7.
At 8½ o'clock: Jan. 14.
At 8 o'clock: Jan. 22.

At 9½ o'clock: December 30.

NIGHT SKY: DECEMBER AND JANUARY

The Heavens.

Turning our gaze overhead, we find Auriga close to the zenith. The brilliant Capella may serve as our landmark. Beta Aurigæ is close by on the east, almost in the line toward Castor and Pollux, which are conspicuous at an altitude of about 45 degrees. Procyon shines on the right, lower down, and Regulus, with the Sickle of Leo, is rising a little north of east.

In the southeast is the magnificent group of constellations centering in Orion. Sirius, still lower down, but surpassing all other stars in brilliancy, so outshines the other stars of Canis Minor that it is only when we hide him from view that we realize that some of them are as bright as the stars of Orion's belt. High up near the zenith is Taurus, now made conspicuous by the ruddy Mars, which exceeds even Sirius in brilliancy.

The constellation of the Hare and the Dove, below Orion, though small, contains more stars of fair brightness than does the vast extent of the sky to the westward, occupied by the winding course of Eridanus. Cetus, farther to the right, is more conspicuous.

Due west from the zenith we find Perseus, then Andromeda, and finally Pegasus. Between these last and Cetus are the little triangle of Aries and the extensive but inconspicuous constellation Pisces.

This is the faintest of the zodiacal constellations, except perhaps Cancer, but makes up for this by some faint resemblance to the two fishes bound together by a cord, which are its traditional likeness.

This cord, or rather cords, start at Alpha Pisceum, a fairly conspicuous star of the fourth magnitude, pointed out by a line from α and through γ Ceti. From this one line of faint stars runs northward toward δ Andromedæ to the Northern Fish, which is represented by a group of faint stars south of β Andromedæ. Another and rather more conspicuous line of stars runs west from α Pisceum for about 30 degrees to the Southern Fish, whose body is marked by an irregular polygon of small stars south of the great square of Pegasus. Our initial letter shows the general arrangement of the constellation.

In the northern sky, Cassiopeia and Cepheus are on the left of the Pole, Ursa Minor and Draco below, and Ursa Major coming up on the right.

The Planets.

Mercury is evening star until the 25th, and afterward morning star. He is apparently farthest from the sun on the 7th, but, being very far south, is unfavorably placed, and sets about 5:40 P. M.

Venus is morning star, very conspicuous and brilliant, rising about 3:10 A. M. on the 1st, and 4 A. M. on the 31st. She passes eastward and southward from Virgo almost into Scorpio during the month, and, telescopically, appears like the Moon two days past the first quarter. Mars is in Taurus, just past opposition,

(Continued on page 506.)

The Inventor's Department

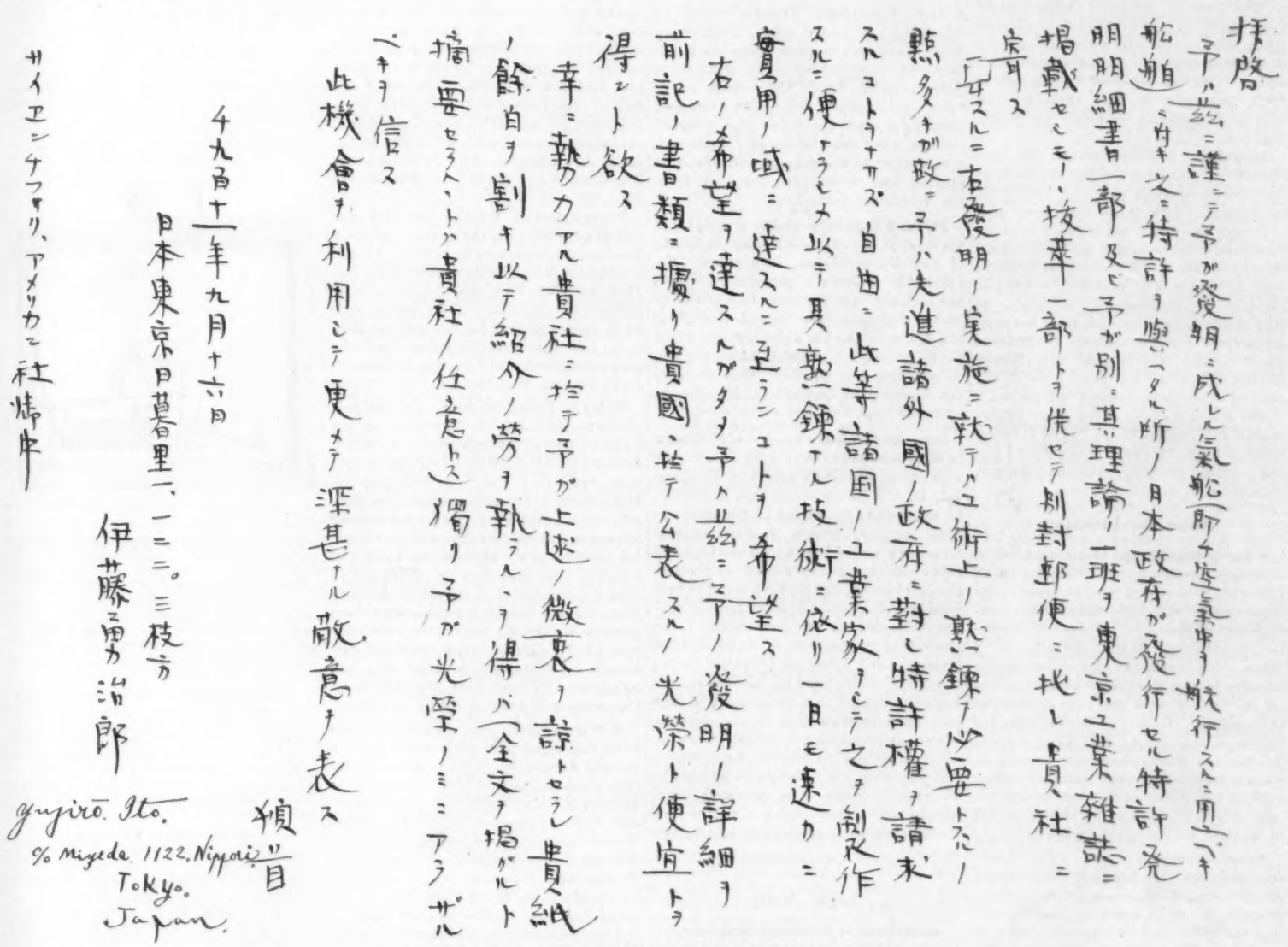
Simple Patent Law; Patent Office News; Inventions New and Interesting

A Letter from Japan.

THERE is scarcely a nook from the Straits of Magellan to Alaska, and from Siberia to the Cape of Good Hope, that is not reached by the SCIENTIFIC AMERICAN. Hence it follows that the Editor's mail includes letters from all quarters of the earth. The questions asked him run from the classic problem of the hare and the hunter to the request for a formula for trisecting an angle. As a rule, these letters are written in English or in one of the familiar European languages. Occasionally the Editor is puzzled by a letter written in characters which are beyond his use with their expert technique, without delay.

"In order to fulfill my desire, I wish to have the honor and facility of having the details of my invention made public in your country by the papers I am submitting you. I shall feel greatly honored if your esteemed firm give consideration in this matter and has the kindness to introduce my invention in your valued magazine. I will leave it entirely to your own convenience whether you use the full text or its outline. With great respect, I remain, Very truly yours,

"YUJIRO ITI."



A letter from Japan to the Editor of the Scientific American.

ken. Only the other day a communication was received from Japan, which is reproduced herewith for the benefit of those who may prefer to read it in the original. Needless to say, the Editor had to ask a Japanese friend for the following translation:

"THE SCIENTIFIC AMERICAN:

"Dear Sirs: I am sending you under separate cover, a copy of patent specification published by the Japanese Government, for an airship invented by myself and for which patent was awarded, also a cutting from *Tokyo Kogyo Zasshi* (*Tokyo Industrial Magazine*) to which I had contributed a portion of the theory.

"As a matter of fact, technical skill is necessary in the practical application of this invention, therefore, I am not going to secure patents from the governments of progressive foreign countries, but my desire is to facilitate the manufacturers of these countries in manufacturing my invention and in putting it into practical

The Japanese patent referred to is in the Editor's drawer, and he will be glad to show it to any one who thinks he can make use of the invention.

The Original Organic Patent Act

THAT our forefathers realized the importance of inventions and appreciated the part they would play in the development of our material resources, is shown by the serious attention paid, in framing the constitution, to the patent and copyright clause and the early enactment of the organic patent act of April 10th, 1790, by the Congress. The Departmental proceedings under this act, looking to the grant of patents, is interestingly told in the following extract from the *Patent Official Gazette* of October 9th, 1877:

By act of April 10th, 1790, the first American patent system was founded. Thomas Jefferson inspired it, and may be said to have been the father of the American Patent Office. He took great pride in it, it is said, and gave personal consideration to every application that was made for a patent during the years between 1790 and 1793, while the power of revision and rejection granted by that act remained in force. It is related that the granting of a patent was held to be in these early times a weighty event in the history of the State Department, where the clerical part of the work was then performed.

It is a matter of tradition, handed down to us from generation to generation by those who love to speak of Mr. Jefferson and his virtues and eccentricities, that when an application for a patent was made under the first act, he would summon Mr. Henry Knox, of Massachusetts, who was Secretary of War, and Mr. Edmund Randolph, of Virginia, who was Attorney-General, these officials being designated by the act, with the Secretary of State, a tribunal to examine and grant patents; and that these three distinguished officials would examine the application critically, scrutinizing each point of the specification and claims carefully and rigorously. The result of this examination was that during the first year a majority of the applications failed to pass the ordeal, and only three patents were granted. In those days every step in the issuing of a patent was taken with great care and caution, Mr. Jefferson seeking always to impress upon the minds of his officers and the public that the granting of a patent was a matter of no ordinary importance. During 1791, thirty-three patents were granted, in 1792 eleven, and in 1793 twenty, making sixty-seven under the first statute.

New Roof for Patent Office Building

THE Patent Office has just been supplied, at a cost of something like four thousand dollars, with a new roof of slag replacing one that has served as a covering for the building ever since the great fire of 1877. It is interesting to compare the difference in cost between the new roof and the old. The one just removed was of sheet copper, but was found to be fairly riddled with holes and cracks from exposure to the elements for more than thirty years. The copper roof cost in the neighborhood of $40,000 or ten times as much as the new one which is being provided by the present Administration. It is stated by some of the older employees of the Interior Department that at the time the old copper roof was laid, there was a regular epidemic of graft, workmen engaged on the roof being detected in carrying away whole sheets of the copper concealed about their clothing. Even the tiniest scraps of copper were stolen, so difficult was it seemingly for the laborers to resist the temptation to acquire scraps of the valuable copper which was almost legal tender. There remains to-day hardly enough of that roof to justify the trouble and expense of carting it away.

Emery Disappearing Carriage

IN the 21st report (October 31st, 1911) of the Board of Ordnance and Fortification to the Secretary of War, we find a reference to the Emery disappearing car-

riage. In the report the Board says: "There have been no developments, so far as the Board is informed, in connection with the Emery gun carriage, and the board can only repeat what has been said heretofore in regard to the history of this carriage. All the work on the Emery design has been done under direct legislative enactment, and the only part to be taken by the Board in the matter is that, when completed, if ever, the carriage is to be tested under its supervision." The report goes on to refer to the several special acts of Congress, beginning with that of February, 1893, and appropriating $130,000 up to the Act of May 27th, 1908, and concludes its reference to the matter as follows; "In its last annual report the Board stated that 17 years had elapsed since the construction of a carriage of Emery's design was first authorized. This remark may now be varied by saying that 18 years have passed and the government still has nothing to show for the expenditure of 95 per cent of the appropriations except the foundations for the carriage which were put in three years ago in order to enable Mr. Emery to obtain an additional $5,000 as provided by the act of 1908, practically the first which required him to do anything in return for money paid him."

According to the report, of the $114,343.02 available for the execution of the present contract with Mr. Emery for his carriage, $100,811.51 has been paid him, and the report says:

"There may be added to the $114,000 mentioned above the sum of $135,656.98 paid under the first contract, which was canceled by congressional authority, so that the total amount authorized has been a quarter of a million dollars. Of this sum there remains to be paid Mr. Emery $13,531.51, or slightly more than 5 per cent of the total amount authorized."

The Board includes seven Army officers headed by Leonard Wood, Major General, Chief of Staff, President of the Board and one civilian member, William Warner.

Notes for Inventors

A Lamp Dimmer for Motor Cars.—The extremely brilliant and dazzling head lights of motor cars are at times very objectionable and some municipal regulations forbid their use. Warren A. Greenlaw of Melrose, Mass., provides, in a patent (No. 1,005,197) for dimming the lamp by sliding the burner away from the strong focal or reflecting point in front of the reflector. To do this, he supports the burner so that it can slide longitudinally and utilizes fluid pressure to move the burner from its normal position. This enables the driver of the car to dim his light whenever desired by sliding it out of its focal relation to the reflector.

Novel Wrench.—In patents No. 1,004,561 and No. 1,004,562, William Henry Joseph Fitzgerald of Braintree, Mass., shows a wrench in which the shank carrying the fixed jaw is tapered, reducing toward the fixed jaw, the sliding jaw has a tapered shank sliding on the shank of the fixed jaw and a yoke encloses both tapered shanks and can be conveniently set to secure the sliding jaw in any desired adjustment.

Lubricating Air Brakes.—Edwin A. Emery of St. Louis, Mo., has patented (No. 1,004,000) a lubricating means for fluid pressure brakes in which is provided means for charging the air in the train pipe with a lubricant. A pipe connects the exhaust port of the triple valve to the chamber at the non-pressure side of the brake cylinder piston in order to vent the lubricant laden air released from the brake cylinder to the said non-pressure chamber to lubricate such chamber.

Novel Initiating Apparatus.—Some secret societies employ many mechanical aids in connection with their introduction of new members. Such a device is shown in patent No. 1,004,857, and presents the appearance of an ordinary platform scale. The platform, however, is collapsible and as it falls, operates an alarm mechanism. The candidate by moving the scale beam releases locking devices and the platform on which he is standing falls and sounds the alarm. The patentee is Erastus De-Moulin of Greenville, Ill.

Preserving Corn With Tar.—To preserve corn in the ear and with the husk on is the purpose of patent (No. 1,004,033) to Benjamin F. Johnson of Macclenny, Fla. In doing this, he ties the husk beyond the tip end of the ear with twine and then submerges it in pine tar. A coating of dust is then applied after which it is plunged into air slaked lime.

Advertising Novelty.—Robert Klotz of Chicago, has patented (No. 1,004,660) as an advertising novelty, a device including a head having a pivoted jaw and a movable tongue. Associated with these is a drawer which can be utilized for any purpose and means are provided so that the movement of the drawer operates the jaw and tongue of the head.

New Vulcanizing Process.—John R. Gammeter of Akron, Ohio, assignor to B. F. Goodrich Company, same place, has patented (No. 1,004,865) a method of vulcanizing in which the tubing to be vulcanized is inflated and a band is wrapped spirally around the tube, the wrapped portion being simultaneously fed through a vulcanizer at the same rate the band is applied, and unwrapping the band from the vulcanized portion.

Fly for a Coat.—Ordinarily garment flies are open at the edge. Abraham D. Goffin of New Haven, Conn., in a patent (No. 1,004,869) presents a garment fly which has a closed edge the inner flap of the fly having a button hole formed through it and the same flap has a slot through which the finger may be passed in buttoning and unbuttoning the garment, thus avoiding the necessity of having the fly open at its outer edge.

Increasing Relative Amount of Hydrogen in Hydrocarbons.—Dr. David T. Day, the well-known petroleum expert of Washington, D. C., has patented (No. 1,004,632) an apparatus for treating hydrocarbons in which an intermediate oil chamber connects with one of the vapor chambers and tubes connect the vapor chamber through the oil chamber, the purpose being to produce hydrocarbons containing more hydrogen than before, in proportion to the amount of carbon, and in doing this the hydrogenating tubes are immersed in the body of oil which is being distilled and are heated by the oil to a temperature as high as or greater than that of the distillate vapors, thus utilizing the heat of the oil for superheating the commingled hydrogen and oil vapor and effecting saturation of oil with hydrogen, the saturated vapor passing off to an outlet chamber and thence through a goose neck to the condenser.

Legal Notes

Assignment by Trustee in Bankruptcy.—In deciding Ex. p. Eyton O. G., 171, pg. 481, the Commissioner of Patents, in denying that portion of the petition which asked that the patent, when granted, be issued to the assignee as requested, said:

"To investigate the laws of various foreign countries in order to determine the titles to applications for patents pending in this office filed by foreigners who have subsequently become bankrupt would place an enormous and unnecessary burden upon the office. Since it is unquestionably proper to issue the patent in the name of the applicant, this is believed to be the safe rule in such cases. In the present instance petitioner has not shown that any hardship would result from following this plan."

In the Hubert case, decided September 11th, 1911, published October 17th, 1911, the Commissioner of Patents held that if an assignment be of record, transferring the entire right, title and interest without any qualifications or reservations, and said instrument contains a request to issue the patent to an assignee, such action will be taken by the office, even if licenses be also of record. Also that a patent will not be issued in accordance with the request contained in an alleged assignment which is made subject to any exclusive license.

Conflicting Patent Decisions.—Two interesting decisions, handed down in different districts of the Seventh Circuit, have recently been published. The state of facts in both cases was practically identical, that is infringement of the Claude and Hess patent (No. 664,383) and the effect upon this patent of the inventors' English patent, dated June 30th, 1896, which expired by limitation June 30th, 1910. This patent concerns the use of acetone as an absorbent for compressed acetylene and appears practically to dominate the packaging of acetylene in cylinders in this country. The important claims in this patent cover a so-called gas package, while the English patent relates to the process. The defendants contended that the two patents were for the same subject-matter and that, under the provisions of Sec. 4887 R. S., the American patent expired with the English. Judge Kohlsaat decided that they were for the same matter and denied an injunction (See 188 F. R. 85). Judge Dennison, a few weeks later, held that the two patents were for different subject-matter and that, according to the Leeds & Catlin case, 213 W. B. 301, the American patent was still in force (see 188 F. R. 89).

Presumption in Reissue that Law was Complied With.—In the case of the John Kitchen, Jr., Company v. Levison (Circuit Court of Appeals, Ninth Circuit, July 3rd, 1911, 188 Fed. Rep. 658) the Court said: "From the reissuance of the patent it is to be presumed that the law was complied with and the proceedings can only be impeached for fraud," quoting Seymour v. Osborne, 11th Wall. 516-543.

Mileage Ticket Decision.—In the case of Rand, McNally & Company, in the Circuit Court of Appeals, Seventh Circuit, January 10th, 1911, rehearing denied April 11th, 1911, the Court held that the Richardson & Langston patent (No. 669,-489) for a script book, containing a series of coupons to be detached and exchanged for passage-tickets, the essential feature of which is that the units are expressed in money instead of in miles, as in the ordinary mileage tickets, which adapts them to more convenient use on transportation lines having different rates, disclosed patentable invention, and is valid; also held infringed. In this case District Judge Carpenter filed a strong dissenting opinion.

A Warning from the Bench.—It is not often that a judge on the bench will give a general warning to practitioners such as that given in the Court of Appeals of the District of Columbia in the case of American Stove Company v. Detroit Stove Works, and Barstow Stove Company. Barstow Stove Company v. Detroit Stove Works, and American Stove Company. In the decision, Mr. Justice Robb in his usual clear and forcible manner, said:

"We have observed a tendency on the part of patent attorneys to disregard the rules of evidence by asking questions more or less leading and suggestive, and it may not be amiss to state that where timely objection is noted in the record, this court will be disposed to apply the rule and entirely disregard such testimony. The witness instead of giving his independent recollection of past events becomes, by this practice, a mere echo whose recollection stimulated by leading questions keeps pace with those questions. The practice is objectionable and subversive of justice, and should be stopped."

"Penny a Pound Profit."—In the case of *ex parte* Loft, Asst. Commissioner of Patents Tenner holds that writing a descriptive word in a distinctive manner does not render it registrable as a trade-mark and that the phrase "Penny a Pound Profit" is discriptive as applied to candy. In reaching his conclusion the Asst. Commissioner says the phrase is in his opinion clearly descriptive of the quality of the goods and is also of an advertising character.

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

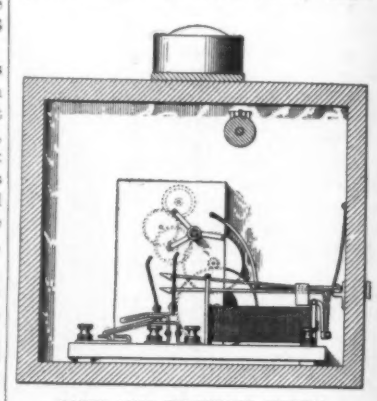
Pertaining to Apparel.

SUNSHADE.—R. F. BICKERTON, 924 New York Avenue, Washington, D. C. This shade is designed for use in shielding the wearer from the sun at ball games and other athletic sports, fishing and the like; and the object is to provide a shade easily applicable to an ordinary hat and can be adjusted to any desired position around the hat in order to properly protect the wearer from the sun.

SKIRT MARKING DEVICE.—F. B. DAVENPORT, 33 Welles Building, Wilkes-Barre, Pa. The intention in this case is to provide a device arranged to permit convenient marking of a skirt along the lower end, with a view to obtain an accurate bottom line a desired distance above the floor, and to permit of observing, after the skirt is finished, whether the bottom edge is the desired distance from the floor.

Electrical Devices.

PARTY LINE TELEPHONE SYSTEM.—EDWARD STOUT and JOSEPH S. KUPKA, Stockfort, Iowa. In this case the more particular purpose is to produce a reliable system in which the number of telephones may be considerable and in which the selectivity of the particular station or stations to be called is rendered comparatively certain. Provision is made for calling one or any larger number of subscribers, to the exclusion of all other subscribers upon the line. The system further compre-



PARTY LINE TELEPHONE SYSTEM.

hends means whereby a single station may call up simultaneously all other stations on the line. It also relates to lock-out mechanism, whereby when any two or more stations are connected up for talking, all other stations are excluded and are unable to interfere with business being transacted over the line. The engraving shows the electrically-operated contact mechanism forming part of the switch and controlling various circuits.

TRANSFORMER SYSTEM.—H. C. CALDWELL, Fort Michie, New London, Conn. This invention relates to transformer systems, the more particular purpose being to provide such a system in which a peculiar advantage is taken of the fact that time is required for the magnetic field to flow, under the influence of variations in the exciting electric current.

Of Interest to Farmers.

SHOCK LOADER.—G. H. TARVIN, care of A. Arrowsmith, L. B. 194, Sisseton, S. D. This invention relates to a loader adapted to run along the field and pick up a shock of hay or grain and deposit it in the wagon rack carried therewith. It provides a device with a fork adapted to scoop a bundle of grain or a pile of hay off the ground, and an auxiliary swinging fork adapted to remove the material from the fork and deposit it in a rack.

CORN PLANTER.—M. H. BIRD, Sandersville, Ga. The main object here is to provide means for feeding the corn at stated intervals. To this end a hopper is arranged having a sliding feed mechanism adapted to be operated by a colter wheel. The hopper and feed mechanism are loosely connected to the main frame so that when an obstruction is met, the feed mechanism may rise to pass over it, automatically settling again into the furrow when the obstruction is passed.

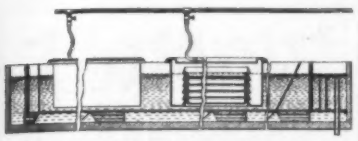
Of General Interest.

ROOF FRAMING SQUARE.—H. H. CRISS, P. O. Box 603, Globe, Ariz. This invention is an improvement in roof framing squares, and the object of the inventor is to provide a simple device by means of which rafters of all kinds may be laid off with absolute correctness, and without the necessity of any calculation upon the part of the user.

FACIAL MASSAGE APPARATUS.—G. C. BECK, 51 Highland Avenue, Minneapolis, Minn. This apparatus is for use in applying hot water to the face, and is an improved substitute for hot-towels commonly used for facial treatment. It includes a water pan or open-top receptacle having attachments for in-

flow and outflow of hot water, and a device adapted to be held in the mouth for supplying air to support respiration while the face is held immersed in the water in the pan.

TROUGH FOR FISH HATCHERIES.—FRANK PARRY, 19 Beatrice Street, Toronto, Canada. The engraving herewith shows a vertical section of a hatchery trough constructed and arranged in accordance with the present invention, which has for its principal objects the provision of means for subjecting the "fry" while in the trough to the action



TROUGH FOR FISH HATCHERIES.

of flowing water, while preventing the same from passing through the trough; the provision of means for causing the water in the incubation trough to flow upward therefrom to lift the "fry"; and the provision of means for mechanically altering the direction of the current flow in the trough. .

ATTACHMENT FOR HYPODERMIC SYRINGES.—JOSEPH MCCANN, 1087 Denison Avenue, Columbus, O. In this invention the improvement is in syringes in which the needle is inclosed and protected by a cap that is detachably connected with the body or barrel of the instrument. The attachment is shown in the engraving in connection with the

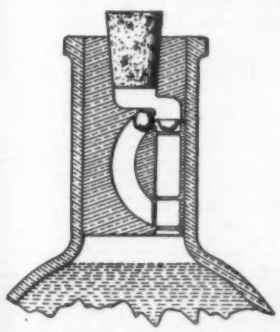
ATTACHMENT FOR HYPODERMIC SYRINGES.

syringe. It comprises the detachable needle-cap, a case containing extra needles and wires for cleaning them, and a safety-pin, for fastening, these parts being connected by chains, so that the case, cap, and syringe proper in which the cap is applied when the needle is not required for use, may be all suspended from the clothing of the physician or nurse and thus may be available for instant use.

RESPIRATOR.—W. I. COCKE, Port Washington, L. I., New York. This invention comprehends a mask to be applied to the wearer's face and held in position by a strap or the like, a flexible tube connecting the mask with the outer atmosphere through the medium of an inlet valve; the mask being further provided with an outlet valve for discharging the air as the same is breathed.

PHOTOGRAPHIC MAGAZINE CAMERA.—R. GOLDSTEIN, 330 East 120th Street, New York, N. Y. This camera is arranged for daylight loading and for quickly and successively discharging the exposed sensitized plates from the camera into a tank filled with a developing fluid, and for preventing the plates from being light struck while in the camera or while being transferred from the camera to the tank.

NON-REFILLABLE BOTTLE.—STEVE O. STANICH, 501 East Eighth Street, Anaconda, Mont. This invention provides a bottle having a neck of the shape shown in the engraving. Fitting tightly in the neck a closure has an opening for the reception of a cork, this opening communicating with the interior of the bottle by means of a passage having three valve seats. A by-pass communicates at

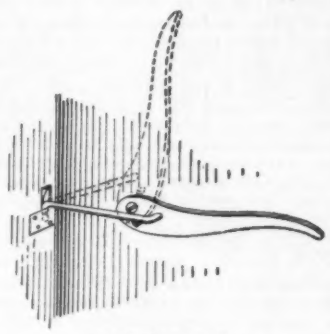


NON-REFILLABLE BOTTLE.

its top with the upper portion of the passage, but is normally cut off from the lower portion of the passage by means of a thin glass plate. Above the valve seat at the top of the passage is a valve while in the upper portion of the by-pass is a ball connected to the valve by means of a thin glass strip. These novel means permit the outflow of the liquid, but will prevent introducing a liquid into the bottle.

Hardware and Tools.

HASP FASTENER.—A. H. BROWNE, R. F. D., No. 6, Lebanon, O. This fastener is for use on hinged and sliding doors. In the engraving it will be seen that during the operation of bringing down the lever the drawer is drawn tightly against the frame and at the same time securely locked. The door is thus not only secured, but a weather-proof joint is formed between it and the frame, so



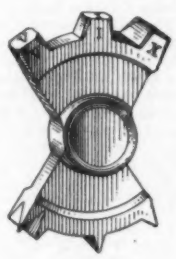
HASP FASTENER.

that it cannot be rattled by the wind and the entrance of moisture is effectually prevented. It may be made in rights or lefts, for the application of the right side or left of a door frame. It is particularly applicable to doors of tobacco barns, and similar buildings requiring ventilation, since by employing different keepers the door may be held open more or less and yet securely.

PAPER HOLDER FOR SCALES.—L. E. ZIMMERMAN, 605 N. 5th Street, Pekin, Ill. An object here is to provide an attachment to hold a paper covering upon the scale plate, thereby keeping the plate clean and in a sanitary condition. The attachment holds the paper firmly in position and yet is out of way of the article so that the latter can be placed on the plate in the usual manner.

SPRING HAMMER.—J. H. PHILLIPS, care of T. B. Anderson Construction Co., ½a Main Street, Oklahoma, Okla. This portable hammer is for shop or field work, and is adapted to be used in various operations, such as riveting, punching, calking, shearing, spike driving, stone, brick and concrete drilling, etc. This automatic trip hammer receives its motive force from a compressible spring, the latter having means thereon whereby the tension may be adjusted.

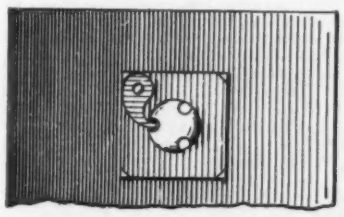
MARKING TOOL.—JOSEPH A. WICKES, 54 Broadway, East Somerville, Mass. The marking tool illustrated herewith represents an invention, which has in view to provide a tool with marking faces having corresponding oppositely extended distinguishing features; and to provide in a marking tool a plurality of hammer



MARKING TOOL.

heads bearing distinguishing marks identifying the character being printed. It is adapted for punch or print markers wherein cutting dies are employed to be driven or struck into the surface of the material. It, however, may be adapted for marking with soft rubber type and this without requiring inventive genius or act.

NUT LOCK.—H. T. EARLES, Mount Morris, Pa. This invention relates to nut locks, more particularly to the "nut carried pawl" type, and has for an object to provide a device of this class for removably securing a nut to a bolt to prevent the nut from being released from the bolt by any vibration or the like.



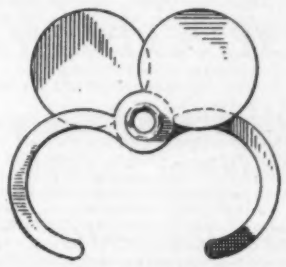
"NUT-CARRIED PAWL" TYPE OF NUT LOCK.

For this purpose use is made of a nut having a pawl thereon, a swaged pin for movably securing the pawl, and a bolt provided with grooves adapted to removably receive an end of the pawl to secure the nut to the bolt. The illustration gives a view looking at the end of the bolt and showing the nut lock secured thereto.

PAPER CUTTER.—M. FAUSSONE, P. O. Box 405, Ouray, Colo. This invention is an improvement in paper cutters and especially in that class of cutters wherein the paper is supported in the form of a roll and is drawn from the roll as used and is cut off in the desired lengths. Means provide for securing a clean cut in tearing the paper off along the blade.

LOCK.—M. G. JADRONJA, 1149 First Avenue, New York, N. Y. This invention has for its purpose the provision of a lock whereby the bolt will be released and assume an unlocked position when a key is inserted in the lock in the usual manner to operate the same. Besides being secured to the side of a door the lock can be employed in any convenient manner such as a mortise lock or the like.

KEY RING.—CHARLES SCHUMACHER, 715 First Avenue, N. S., Pittsburgh, Pa. Among the principal objects which the present invention has in view are: to provide a ring having arms frictionally held to form a ring; to provide a pivot eyelet for attachment to a chain; and to provide a device of the construction set forth with a plurality of advertising plates, two of which are covered during the major portion of the time. The device is illustrated herewith and it shows a side view of a ring



KEY RING WITH PLATES.

in open position. The solid plates at the top are employed as a means for advertising articles and for imprinting thereon the name and address or other information relative to the owner to serve as a partial identifying article. The inventor invites correspondence in reference to the sale of this improvement.

Heating and Lighting.

LAMP ATTACHMENT.—H. LEHMANN, 914 Washington Street, Waco, Tex. This invention has reference to lamp attachments, and the object is to provide a device for use in preventing lamp explosions, to serve as a means for heating liquids over a lamp and to prevent the cracking and breaking of lamp chimneys.

Household Utilities.

AUTOMATIC DISINFECTING DEVICE.—T. F. HAHESY, 78 Maverick Street, Chelsea, Mass. The present invention has reference to an automatic liquid disinfecting device, which is adapted to be attached to the flushing tank of a water closet, whereby a certain amount of disinfectant may be supplied to the water in the tank each time the tank is operated.

Machines and Mechanical Devices.

WASHING MACHINE.—E. KOHAN, Port Ewen, N. Y. This apparatus will wash clothing without rubbing, whether mechanically or by hand. It cleanses simply by the physical action of running water and air, the water carrying a proper amount of dissolved soap, and it cleanses gently, but thoroughly, without the wear and tear usually met with when clothing or the like is washed by hand or laundried by machines.

SAFETY GATE FOR ELEVATORS.—H. L. BRAYTON, 225 South Howell Street, Owosso, Mich. This improvement relates to means for opening and closing elevator gates automatically by the movement of the elevator cage or car, and the aim is to provide a mechanism which will be located entirely in the elevator shaft, readily accessible in all its parts, and which will not require any counter-weights.

CALF WHEEL REEL.—T. A. BEECHER, Taft, Cal. In this patent the invention has reference to artesian and oil wells, and has for its object to provide a wheel and shaft for use in raising and lowering casings into drilling wells, and, as known among those skilled in the art of well drilling, a further object is to keep the casing loose.

COMBINED BULL WHEEL, TUG WHEEL, AND MOUNTING REEL THEREFOR.—I. A. BEECHER, Taft, Cal. This invention provides a construction to withstand shocks to which structures of this character are subjected; provides to facilitate a division of the reel for winding the cable whereby a plurality of cables may be employed; provides a structure evenly and firmly keyed to the supporting shaft to distribute torsional strains of the structure, and provides means for readily truing the bearing of the structure on the shaft and to eliminate vibration from the structure.

MEANS FOR TEACHING AVIATION AND TESTING AEROPLANES.—W. F. MANGELS, Coney Island, New York, N. Y. A means is provided in this invention to enable a person to acquire with the utmost safety all the necessary skill and confidence required for a flight in the open air with an aeroplane or other flying machine, and to allow aviators to fully test the motors and other parts with safety to themselves and the aeroplane.

REVOLVING PLANE.—J. HAYTON, Box 358, Salt Lake City, Utah. This invention has reference to revolving planes for flying machines, to take the place of the stationary planes now used therein. An object is the provision of a device which will be simple in construction, inexpensive to manufacture, strong, durable, easily controlled, and having a great supporting efficiency.

Pertaining to Recreation.

CUE RACK.—M. R. BASS and W. A. ALEXANDER, 2 Oneida Street, Boston, Mass. This rack is so constructed as to provide for imparting longitudinal compression to the cue while in the rack, for repairing the tips of the cues, and at the same time to so support the cues while under the compression action, as to prevent lateral movement of the cues. The rack can safely hold the cues when inserted therein, and prevent their withdrawal without the consent of the user or owner of the cues.

GAME APPARATUS.—J. V. B. RAPP, 507 Fifth Avenue, Brooklyn, New York, N. Y. In this game use is made of a field having the home plate and bases marked thereon, indications of plays adjacent the home plate and bases, and a revoluble spinner or pointer pivoted to the center of the field and having four points adapted to indicate on the said indications on the home plate and bases.

REEL.—H. HALL, Paonia, Colo. This invention relates generally to reels adapted to be applied to fishing rods, such as is the subject-matter of the patent No. 977,732 formerly granted to Mr. Hall, and more particularly it relates to a reel having gearing therein cooperating with the reel proper and the handle, whereby successive turning of the handle in opposite directions will cause the line to wind up in the reel.

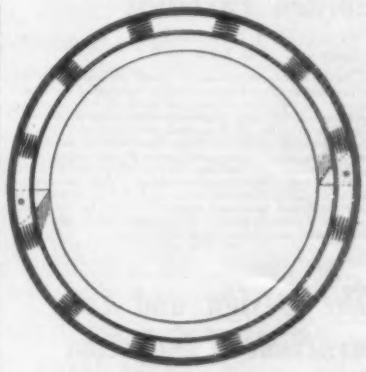
Railways and Their Accessories.

METALLIC RAILWAY TIE.—J. N. KEMMERER, Loganton, Clinton Co., Pa. In the present patent the object of the inventor is to provide a metallic tie which shall combine maximum strength rigidity, and lightness, and may be manufactured at a low cost, may be easily placed in and removed from the roadbed, and will support rails firmly without danger of moving endwise.

Pertaining to Vehicles.

RESILIENT WHEEL.—F. MORRIS, 2912 Farnam Street, Omaha, Neb. This improvement pertains to resilient vehicle wheels or combined cushion and pneumatic tire wheels. An object of the invention is to provide a wheel which will have the same resiliency as an ordinary pneumatic tire wheel, but which is so constructed that the pneumatic tire does not come in contact with the ground and is thereby protected against puncture.

TIRE FOR WHEELS.—FRANK GALLAGHER, Route 2, Canton, Minn. In this patent the invention has reference to tires for wheels, and it has for its object the provision of a tire which may be readily adjusted to a wheel,



TIRE FOR WHEELS.

the tire being provided with springs as shown in the engraving, which hold the tread of the tire yieldingly extended from the felly of the wheel. The tire is made in sections which are bolted together around the felly of the wheel. The number of springs in each tire may be regulated with reference to the use to which the tire is to be put. The illustration pictures the tire in longitudinal section.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12569) G. W. G. says: In a recent issue I saw an article referring to a discussion in the English papers of the meaning of the word "anticyclone." Now, it is an interesting fact to which I would call your attention that the word "cyclone" is used by different people to denote each of the three different kinds of atmospheric whirls, which are distinguished absolutely from one another by meteorologists. In the newspaper vernacular it means a tornado; in French, and by implication the other Romanic countries, it means a hurricane or typhoon; while its proper meaning, according to our *American* meteorologists, is a broad flat whirl, known more familiarly as a "low." This is designated in French science by the term *Bourrasque*, which popularly connotes merely a storm. Will you not take this matter up, and inform your readers where and by whom the word "cyclone" was originated, and what it originally signified, and how it came to be appropriated to mean three different things. This would make more clear the true and proper significance of the word, as well as, naturally, that of the word "anticyclone," which appears to be used everywhere in its proper significance, for the obvious reason that there is, and can be, no such thing as antihurricane or an antitornado. A. The word "cyclone" was invented by Henry Piddington, of Calcutta, one of the founders of the modern theory of storms, and first appeared in his well-known "Sailor's Horn-book," published in 1848. It was irregularly formed from the Greek word for circle, and was applied by its author to "all circular or highly curved winds . . . without any relation to the *strength* of the wind." Among the winds coming under this generic designation he enumerates hurricanes, typhoons, whirlwinds, African tornadoes, simoons, and—with a note of interrogation—"some gales of high latitudes." Under the term "whirlwinds" he would doubtless have included what is now called in America a "tornado"—and popularly a "cyclone"—the African tornado being a wind of the squall variety. If Piddington were writing to-day, he would hardly include the latter among the "cyclones." While, with advancing knowledge of the mechanics of the atmosphere, the application of this word has varied from one generation of meteorologists to the next, current usage in regard to it is nearly uniform in all languages. The "Cyklone" of Hann's "Lehrbuch der Meteorologie" (written "Zyklone" by most other Germans) is identical with the "cyclone" of English and American meteorologists; while if our correspondent will consult Hildebrandsson and Teisserenc de Bort's great historical review of dynamic meteorology, "Les bases de la météorologie dynamique," he will find that "cyclone" has the same application in French. Modern scientific usage extends this term to two somewhat different forms of atmospheric whirl, viz., tropical (properly "intertropical") and extra-tropical cyclones; but not to the relatively small and local whirls known as spouts (waterspouts and landspouts—the latter including tornadoes), which are believed to originate in the upper atmosphere, or to the small dust-whirls and the like, due to local convection just above the ground. It must be admitted, however, that many meteorologists are so far influenced by the popular identification of cyclones with violent storms that they avoid the use of this word in writing of the cyclonic wind-systems of middle latitudes, which are not necessarily stormy; preferring to refer to these systems as "depressions," "barometric minima," "lows," etc. The same writers freely apply the word "cyclone" to the moving low-pressure systems within the tropics, where such disturbances always assume the character of storms, and are usually so violent as to deserve their alternative name "hurricane." Thus J. Algué's standard work on typhoons is entitled "The Cyclones of the Far East." *The fact that tropical cyclones are always storms—and usually violent storms—probably explains how the word "cyclone" came to be identified, in the popular mind, with a severe wind-storm.* This particular class of cyclones having been the subject of a great amount of practical literature addressed to mariners, the term probably passed by way of the nautical vocabulary into the vocabulary of everyday life. Popular usage in this country is so nearly unanimous in identifying the cyclone with the tornado that lexicographers have been forced to accord a measure of recognition to this application of the word "cyclone," and it has even received the approval of the law courts. (See an interesting decision of the United States Circuit Court of Appeals reported in the *Monthly Weather Review*, June, 1907, p. 260 ffg.) The word "bourrasque" has, as our correspondent states, been applied in French scientific literature to ordinary cyclonic disturbances, but is now obsolescent in this sense, and was never the *usual* term. A "bourrasque" is properly a violent and transient wind, especially a squall. This term belongs to the family of words—including "bora," "burran," etc.—derived from the Greek "boreas"—the blustering north wind blowing down from the mountains.

(12570) E. Q. K. writes: I wish you would explain the discrepancy between theory and observed facts which I have noticed in regard to the vernal and autumnal equinoxes, the period when the days and nights are equal in length. The dates are about the 21st or 22nd of March and September, according to the astronomers, yet the almanacs report a considerably longer day than night on those dates. Are the almanacs wrong, or do they give times of *apparent* sunrise and sunset; and are there reasons why the apparent time is not the real time of these occurrences?

I take the following from the *World* almanac for 1910:

MARCH.

	Sun rises.	Sun sets.	
18th....	6:9	6:9	(day and night equal on 18th).
19th....	6:7	6:10	(day exceeds night by 3 minutes).
20th....	6:5	6:11	(day exceeds night by 6 minutes).
21st....	6:3	6:12	(day exceeds night by 9 minutes).
22nd....	6:2	6:14	(day exceeds night by 12 minutes).

This would seem to make the 18th the date of the vernal equinox, instead of the 21st.

SEPTEMBER.

	Sun rises.	Sun sets.	
21st....	5:45	6:1	(day exceeds night by 16 minutes).
22nd....	5:46	6:0	(day exceeds night by 14 minutes).
23rd....	5:47	5:58	(day exceeds night by 11 minutes).
24th....	5:48	5:56	(day exceeds night by 8 minutes).
25th....	5:50	5:55	(day exceeds night by 5 minutes).
26th....	5:51	5:53	(day exceeds night by 2 minutes).
27th....	5:52	5:51	(night exceeds day by 1 minute).

Here the autumnal equinox appears to come somewhere between the 26th and 27th of September, while the 21st and 22nd show a large excess of daytime. A. The times of sunrise and sunset as given in the almanacs are those at which the upper edge of the sun appears or disappears at the true horizon. As the sun is half a degree in diameter, and in our latitude goes down obliquely, this takes place 1½ minutes earlier at sunrise, and later at sunset, than the time when the sun's center is on the horizon. This alone would make the day three minutes longer than the night when the sun is at the equinox. To this must be added the effect of atmospheric refraction, which raises the sun, when near the horizon, by half a degree—his whole diameter. This makes sunrise three minutes earlier and sunset three minutes later than otherwise would be the case. The combined effect of these two causes makes the day nine minutes longer than the night on March 21st and September 21st.

(12571) J. E. L. asks: Could you answer the following question to set some minds at rest? It all comes through the baseball series just past. You need not be surprised to hear from such a far western country and from people who seem to be so much interested in the American national game. Mostly all of us come from the East. The question is: Would a *slow* ball, met squarely in the face by a *bat*, rebound farther back than the same ball, being swift, met by the same bat with the same force behind? If it is possible to give some reasons to explain the natural result, it would set many minds at rest. A. Given a ball and bat of regulation weight, and a certain amount of energy between the ball and the bat, the ball will go to a certain distance with a certain velocity. It does not seem to us to make any difference whether the ball or the bat has the energy in equal or unequal portions, if the total energy is the same. That is, if the ball is at rest and is struck with a whole force, it will go with the same speed and to the same distance as if the bat were at rest and the ball struck it with this force, or if bat and ball are both in motion and come together when each has half of this force. In each case the ball will have the same force after rebound. The fact is that such a condition is not realized in an actual game. The batter sees the ball coming swiftly and puts in more force than if the ball is coming slowly, and this is done instinctively. He must put more force into the bat, so that it may have the velocity necessary to find the swift ball before it gets past him. Balls are pitched swiftly, since there is more chance that a swift ball will be missed, and go to the catcher. The specific question which you propose can now be intelligently answered. The swift ball rebounds from the bat further than a slow one can if the bat has the same force in the two instances, because the rebound is the sum of the force of the ball and of the bat. The rebound is due to the entire

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Inquiry No. 9256. Wanted addresses of parties having Pitchblende deposits, if able to ship ore.

Inquiry No. 9257. Wanted addresses of firms selling second-hand water turbines.

force at the point of rebound, that of the bat and the ball. The force of the bat is the same both times, but the slow ball has less force than the swift ball. Hence the rebound of the slow ball is with less force than that of the swift ball. The resulting velocity is less, and the distance to which it flies is less.

The Current Supplement

IN the current issue of our SUPPLEMENT, No. 1874, Marconi, the pioneer of the art of radio-telegraphy, concludes his account of its development.—The largest electric generator in the world has recently been installed by the New York Edison Company on the East River, New York city. An illustrated account of the starting up of this giant turbine and generator furnishes the frontispiece of this issue.—An automatic device for preventing the unduly sudden rise of current on closing the switch of a motor, presenting an important advance in the design of this type of apparatus, is described and illustrated.—The handling of materials, both raw and finished, in manufacturing plants, is a very important problem at all times. Some interesting examples of what has recently been done along these lines are described and illustrated.—A very interesting review of the speed records attained by various methods of locomotion, both on the earth's surface and above it, is reproduced from *Nature*, in which Prof. Hele-Shaw's address before the Royal Institution was originally published.—Mr. J. J. Ide, who has been contributing some very excellent articles on various types of flying machines, this week tells us of the Deperdussin monoplane.—An article containing much useful information on wire and wire ropes in aeroplane construction is reproduced from the *Electrician and Mechanic*.—Our astronomical readers will take interest in an article on the orbit of Beta Persei.—Other subjects tell of the automatic regulation of boiler water, the power derived from ocean waves, and the deceptions to which our senses are subject.

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PRACTICAL APPLIED ELECTRICITY. A Book in Plain English for the Practical Man. Theory, Practical Applications, and Examples. By David Penn Morton, B.S., E.E. Chicago: The Reilly & Britton Company, 1911. 12mo.; 438 pp.; illustrated. Price, $2 net; postage 12 cents extra.

The manual is addressed to those who wish to acquire a general yet practical knowledge of electricity without going so far as to take a complete course in electrical engineering. Only the simplest mathematics are used, and an effort is made to weld indissolubly fundamental principles and practical applications. The arrangement and treatment follow closely the course given in the evening classes of the Armour Institute of Technology, and the manual might be used as a text-book in High Schools and Manual Training Schools. A "Workers' Edition" is also issued, in flexible leather with protecting flap, inside pocket, and memoranda pages, at an advance of fifty cents in price over the regular edition.

NATIONAL PROBLEMS AFFECTING THE LUMBER INDUSTRY. Tacoma, Washington: National Lumber Manufacturers' Association, 1911. 8vo.; 278 pp. Price $1.

The annual conventions of the National Lumber Manufacturers' Association are always productive of many timely and important papers and addresses. The full proceedings of the ninth annual meeting are given by the volume in hand. There are opinions on Canadian reciprocity, able reviews of the business situation, and remarks on co-operation with the leaders of the conservation movement. The more important papers deal with such subjects as workmen's compensation, the principles of efficiency, currency reform, the Panama Canal in its relation to the lumber industry of the Pacific Coast, substitutes for wood, and the railroads and the lumber industry. Some opposition develops toward the Canadian reciprocity bill, and the measure is condemned as agreeing with no economic theory and as being particularly threatening to the prosperity of the lumber industry of the United States.

HANDICRAFTS IN THE HOME. By Mabel Tuke Priestman. New York: A. C. McClurg & Co., 1911. 8vo.; 228 pp. Price, $2 net.

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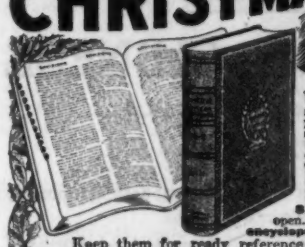

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The Heavens in December, 1911

(Concluded from page 500.)

and very bright. He is south of the Pleiades at the beginning of the month, and moves slowly westward. Telescopically he shows a disk about 19 seconds in diameter, upon which much detail may be seen under favorable atmospheric conditions. By the end of the month his distance has increased from 49 to 64 millions of miles, and he appears correspondingly fainter and smaller.

Jupiter is morning star in Scorpio, rising about 5:30 A. M. in the middle of the month.

Saturn is in Aries, well past opposition, but still conspicuous in the evening sky.

Uranus is in Capricornus, too near the Sun to be observed. Neptune is in Gemini, approaching opposition, but too faint to be seen without a telescope.

The Moon is full at 10 P. M. on the 5th, in her last quarter at 1 P. M. on the 12th, new at 10 A. M. on the 20th, and in her first quarter at 2 P. M. on the 28th. She is nearest the Earth on December 6th, and farthest away on December 21st.

In her circuit of the skies she passes near Saturn on the night of the 3rd, Mars at 11 P. M. on the 4th, Neptune on the 8th, Venus on the 16th, Jupiter on the 18th, Mercury on the 21st, Uranus on the 22nd, Saturn again on the 31st, and Mars once more about three hours after the new year begins.

The two conjunctions with Mars are close. As seen from Washington, the planet is about 15 minutes south of the Moon's limb on the 4th, and about 20 minutes north on New Year's Eve.

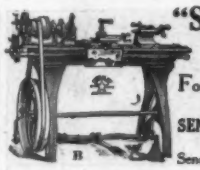
Princeton University Observatory.

The Manufacture of Yeast

(Concluded from page 496.)

passed between cylindrical rollers which bruise it without grinding it to powder. The product is now mixed with water, whereby the so-called must or saccharine liquid for fermentation is obtained. The preparation of this liquor is carried out in double-bottomed macerating tubs, heated by steam and provided with mechanical agitators. The materials fed into these tubs consist of a mixture in about equal parts of flour and barley, the diastase in the malted barley being sufficient to turn into sugar not only the starch contained in the grain itself, but a further quantity, furnished in the form of untreated starch. It is, of course, an economy to malt only a portion of the grain and make it do duty for saccharifying both its own starch and a further quantity upon which no malting operation has been performed. As soon as the saccharification is complete, the product, in form of a doughy slush, is introduced into double-bottomed copper coolers, in which it is cooled down to 20 deg. Cent. From the refrigerator the must is distributed to a number of tubs of 220,000 gallons each, arranged in a special room, whose temperature is maintained constant through summer and winter, as this is an indispensable factor for the successful operation of the process. The tubs are then inoculated with a quantity of yeast carefully prepared. The temperature of the must reaches 25 deg. Cent. at the start, and must not be allowed to exceed 30 degrees. It is important to rigorously observe these limits of temperature and to be scrupulously careful in the preparation of the grain, in maintaining the right proportions for the mixture, and in insuring absolute cleanliness of every part of the plant. From time to time, until the fermentation is completed, the yeast is gathered from the surface of the liquid in the tub. The yeast is then sifted in order to separate it from the malt and the mucilaginous material admixed with it, whereupon it is passed through a filter press which delivers it in the shape of slabs or cakes. Finally, the yeast is stamped in a briquetting press and made up in parcels of one pound, two pounds, and one-half pound, which are carefully packed in double wrappers for delivery to bakers and pastry cooks.

The must, on the other hand, after the fermentation is completed, is carried off to reservoirs in the cellar, whence it is pumped to the stills. By a series of suc-



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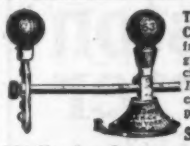

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Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Chinese Wood-oil Tree

To the Editor of SCIENTIFIC AMERICAN:

In your issue of September 23rd, at page 275, you express the opinion that the Tung, or Chinese wood-oil tree, "might flourish in warmer parts of the United States."

My purpose in writing this is to inform you that it does flourish in Louisiana as far north as Red River in the central part of the State of Louisiana. Here at Abbeville, in the southwestern portion of the State, near the Gulf of Mexico, I have several trees measuring nine inches in circumference and over twenty feet high, which mature their fruit and are only four years old. It is of erect habit, handsome appearance, its branches are easily controlled, and I should consider it an ideal ornamental tree for cities where the crowded conditions of tall walls and buildings leave little room for the ordinary trees. It flowers early in the spring, and its blossoms are very beautiful and quite fragrant.

Abbeville, La. C. J. EDWARDS.

Nitrogen and the Soil

To the Editor of SCIENTIFIC AMERICAN:

It has just now come to our notice that in the edition of the SCIENTIFIC AMERICAN published August 19th, 1911, there was a communication from Dr. J. G. Lipman of the New Jersey Agricultural Experiment Station, in which he claims that the priority of discovery that "a legume growing with a non-legume causes the latter to contain a higher nitrogen content than if the non-legume were grown alone" rests with him, or as he expresses it, with the Ne Jersey Experiment Station. If his objection is based on the contention that this fact was announced by him before it was by the undersigned, his position is untenable, as we published conclusive evidence of this in the *Journal of Industrial and Engineering Chemistry*, July, 1910, and also presented it at the Omaha meeting of the American Society of Agronomy, December 7th and 8th, 1909. The latest of these was several months previous to the appearance of the article in the *Journal of Agricultural Science*, Vol. III., Part III., and the note in the Report of the Office of Experiment Stations for 1909 in which Dr. Lipman claims to have made a similar announcement, both of which publications appeared in October, 1910.

Our article on "Availability of Soil Nitrogen in Relation to the Basicity of the Soil and to the Growth of Legumes" contained a detailed description of our investigation, including statements of analysis of the non-legumes grown with and without legumes. This article was received by the editor of the *Journal of Industrial and Engineering Chemistry* on April 21st, 1910, and appeared in July of that year. The articles published by Dr. Lipman in which he claims to have made a similar announcement were the following: "A Method for the Study of Soil Fertility Problems," which appeared in the *Journal of Agricultural Science*, Vol. III., Part III., and was received at the Cornell University Library on October 12th, 1910, and a brief note in the Annual Report of the Office of Experiment Stations for 1909, which publication bears the date of issue October 10th, 1910, on its cover.

It will be noticed that both of these publications appeared several months after our article in the July number of the *Journal of Industrial and Engineering Chemistry*. In neither of Dr. Lipman's publications are any figures given to show that the fact had been demonstrated, that legumes may increase the nitrogen content of non-legumes growing with them.

We have a high respect for Dr. Lipman's work, and have no doubt that he had come to the same conclusion that we had reached as the result of his own work, but we feel that it was only proper that we should make this explanation to show that we announced the fact before Dr. Lipman did, and furthermore published our results in detail. We regret that a public explanation is necessary, but the communication in the August 19th number of this journal requires this. It is altogether probable that Dr. Lipman failed to see our article in the *Journal of Industrial and Engineering Chemistry* before he wrote his communication.

T. L. LYON,
J. A. BIZZELL.
New York State College of Agriculture and Experiment Station at Cornell University, Ithaca, N. Y.

The Naval Review at New York

To the Editor of SCIENTIFIC AMERICAN:

The fleet that was reviewed by President Taft on the second of November was the most formidable ever assembled in American waters, exceeding by a wide margin the allied fleet that participated in the Hudson-Fulton celebration two years ago.

Comparing the Atlantic fleet of that time with the present, we find that the strength in pre-dreadnought vessels is about the same while the addition of the six all-big-gun ships more than offset the foreign vessels that were in the Hudson at that time.

The English flagship "Inflexible" would be easily outfought by the "Delaware," while the three remaining cruisers would be mere stationary targets for the powerful 12-inch gun batteries of the "Utah" and "South Carolina." Admiral Von Roester's German vessels would find the lone "North Dakota" more than a match for them. The ill-fated "Liberté" and her sister ships "Justice" and "Verité," carrying four 12-inch guns each, could make but a feeble fight against the combined attack of the "Florida" and "Michigan." Unaided by the cruisers, the veterans "Indiana" and "Massachusetts" could dispose of the remaining foreign vessels with a few effective broadsides.

GERALD ELLIS CRONIN.
Brooklyn, N. Y.

Upbuilding Our Merchant Marine

To the Editor of SCIENTIFIC AMERICAN:

Since writing you within the past few weeks the writer has eagerly scrutinized your correspondence column, hoping to find some manifestations of interest from your readers on the revival of the American merchant marine. If all the great journals in this broad land would do as much as you have already done to enlighten the public on this subject, the great mass of the people, in the interior especially, would be much better informed in regard to the actual status of our shipping interests. Such information would enable and incline them to send more statesmen and fewer demagogues to Congress, and would result in the enactment of such a shipping law as would stimulate our foreign commercial interests, and at least lay the foundation for such a merchant marine as would command the respect of the nations of the earth.

The situation calls for immediate action, and the friends of American shipping interests should endeavor, if possible, to accomplish something at the approaching session of Congress.

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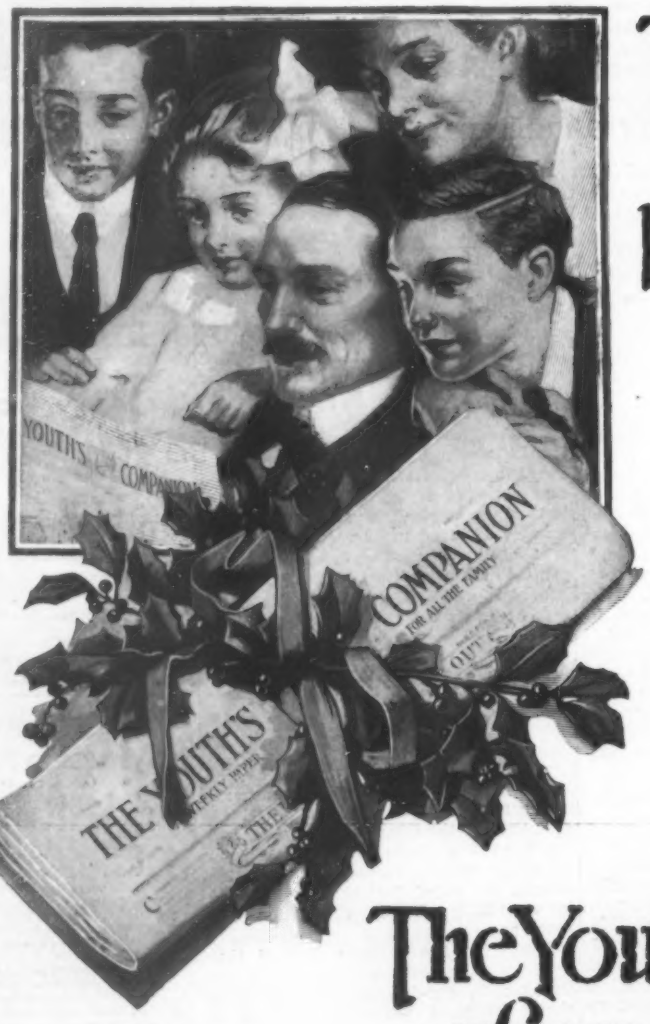

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